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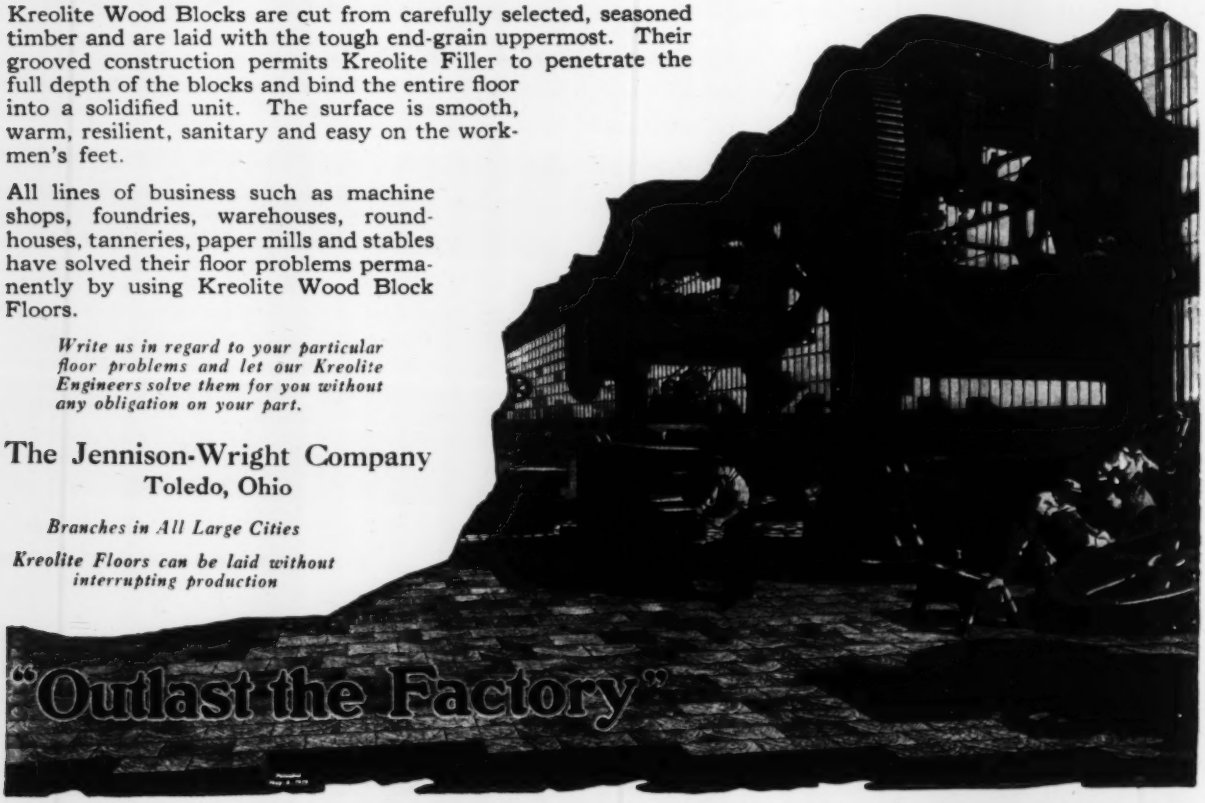

WOOD BLOCK FLOORS

New York, September 6, 1928

Engineering News-Record

A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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(Water-Works)
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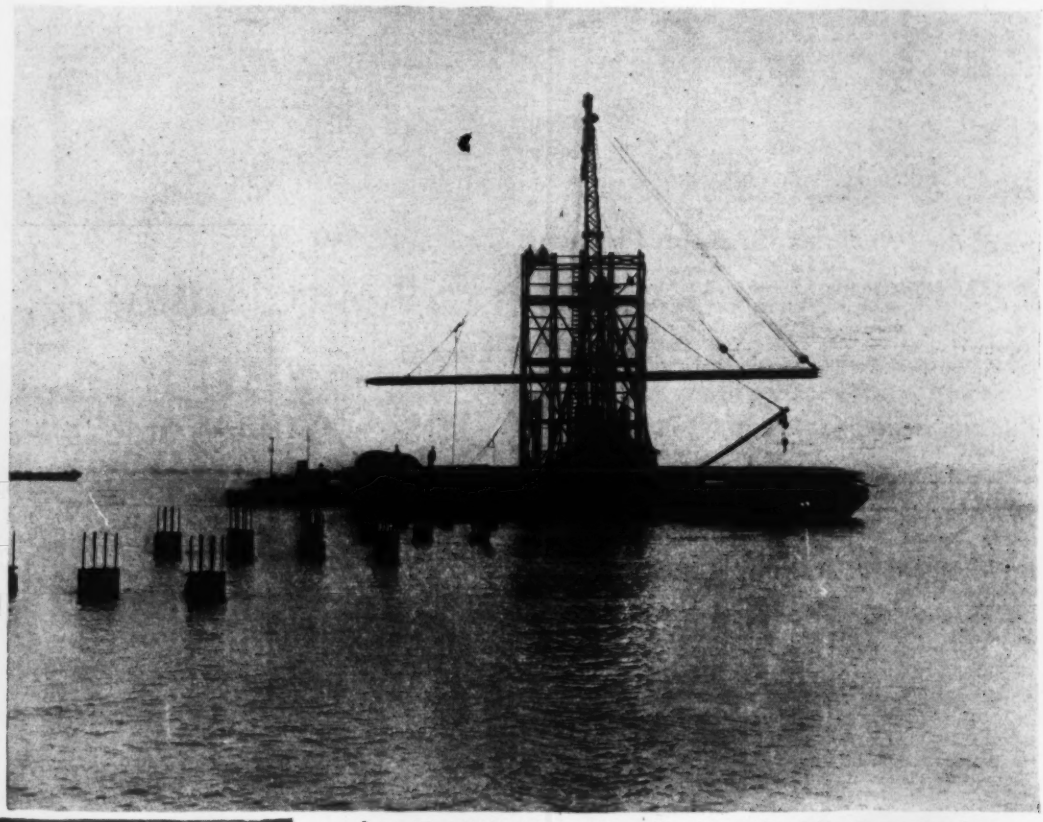

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A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Volume 101 NEW YORK, SEPTEMBER 6, 1928 Number 10

Changes in Design

SINCE Travis separated the settling and digesting functions of the septic tank and Imhoff carried the separation still farther by providing exits for the gases of sludge decomposition there have been many changes in the design of two-story sewage tanks. Some of these have been aimed at improvement in process, some have been chiefly structural, some have had a double aim. A notable example of the combination of the two aims is afforded by the radial-flow cellular type of tank at Flint, Mich., described elsewhere in this issue. The eight advantages for this type given by Mr. Drury are worthy of consideration, including those relating to increased facility of construction. The latter can be more readily weighed after reading a second article on the Flint tanks, dealing wholly with construction, which we hope to publish two weeks from now, in our Sept. 20 issue. But it may be said here that the process advantages of the Flint plant might have been seriously offset by construction difficulties had not precast elements been used extensively in building the tanks.

A Road Improvement

A ROAD improvement that will be gratefully appreciated by quite a few thousands is at issue in the subject of approach slabs, discussed on another page from the standpoint of Ohio practice. The problem involved is old, although it should never have been allowed to exist. Apparently it was left hanging in the air between the bridge builder and the road builder, each referring it to the other. At any rate, rough bridge entrances are exceedingly common, not to say universal. In some few parts of the country a real effort has been made to eliminate the roughnesses, so that the road traveler now and then experiences the surprised pleasure of entering upon and leaving a bridge almost without becoming aware of its presence—a realization of the basic ideal that the roadway over a bridge should be identical in quality with that in normal location. Very probably this result has most often been obtained through meticulous care in consolidating the backfill at abutments and building up the approaches so that there is no break in grade at the bridge. However, the physical conditions are such as to make it logical to accomplish the transition by a slab capable of spanning any soft or settled spot in the backfill. In its careful development of this expedient, Ohio places before us an excellent model. There are enough physical complexities in the problem to make it necessary that the model be applied with judgment, we believe, but essentially it is sound.

The Mississippi Decision

ACCORDING to the findings of the special Mississippi flood-plan board, protection of the Mississippi's alluvial valley from flood destruction is to be accomplished on the basis of the Jadwin plan, which is declared to be better than the Mississippi River Commission's plan in every point of difference. It will be recalled that in formulating his plan on the basis of the commission's plan, General Jadwin made two essential changes. One was to widen the Tensas and Atchafalaya diversion channels in order to cheapen their confining levees, at the cost of submerging more land. The other was to add a floodway on the west bank of the river in the New Madrid region in order to lower flood stages at Cairo, a problem which the commission had left open for future study because of the serious complexity of the factors in the flood situation at this point. Both of the changes depend on hydraulic and economic data largely unknown as yet. The water-carrying capacity of the diversion channels is a matter of optimistic guess at present, and the proper balance of cost between levee construction and land damages is quite as uncertain. The efficacy of the riverbank floodway is subject to grave doubt. A detail of the Jadwin project, the provision of weak levees at the heads of the diversion channels which are to wash out and form crevasses at high water, has with good reason been sharply criticised. None of these vital points of question involved in the comparison of the two plans is searchingly dealt with in the board's report. The report therefore leaves the major problems of Mississippi flood protection to be solved at a later time.

Letter but Not Spirit

IF THE action of the Mississippi flood board disappoints the hope for constructive action on the great problem placed in its charge, this unfortunate result is chargeable to the fact that the board complied with the letter but disregarded the spirit of its mandate. Under the bare terms of the resolution of Congress, the board was to compare the Jadwin plan with the commission plan and harmonize them, and this it can claim to have done. But it was also to inform itself fully and obtain such data as might be needed for determining upon *the best plan*. The spirit of the resolution was that Congress believed the commission plan to have advantages and desired a thorough and fair weighing of these matters by a bipartisan board with a view to obtaining the best and most complete flood-control system. How the purpose of obtaining a balanced board was circumvented by the dismissal of General Potter, head and spokesman of the commission, and the organization of a board made up of General Jadwin, one of his own subordinates and a civilian whom he nominated has already gone down into history. In commenting on this situation two months ago we pointed out that the board was under a peculiarly heavy responsibility in respect to the needed critical restudy of flood-control plans. For it is plain that Congress intended that the best possible project should be developed. It knew that the 1927 plans had been formulated hastily and (for lack of adequate data) were bound to be imperfect, and that conscientious comparison of

the plans would bring out the faults of both. The report is evidence that this result was not attained and that exhaustive restudy of the problem must await another opportunity.

The Tooth of Time

SO MUCH of human labor is spent in fighting the ravages of decay and deterioration that there is genuine encouragement in all news of successful resistance to these destroyers. Such encouragement is found in the Lake Pontchartrain test results on treated timber —nearly half a century of life without measurable loss of strength, and this under physical conditions about as bad as can be found within the United States! Perishable wood evidently can be made almost proof against the attack of decay. The experience gives a strong impulse to the advancing movement toward the use of preservative treatment in every place where decay may reasonably be expected. Under present conditions, of course, the advantage of protection by preservative impregnation is virtually limited to engineering construction —to work permitting of dealing with a distant treatment plant and involving carload lots of material. When we consider that the largest use of wood is in the retail market, through the medium of the ordinary lumberyard, which does not deal in treated material, it will appear that the present situation is not such as to permit the fullest value to be derived from the possibilities of wood preservation. But it is not out of question that when the full value of preservation becomes widely enough realized, marketing systems may be developed by which treated timber will become available in stock.

Unintelligible Station Signs

LITTLE thought seems to be given to station names and to the character and position of the name panels in the stations of the rapid-transit systems of our larger cities. And, with the possible exception of Boston, almost no thought has been given to the use of direction signs for the aid of strangers. Most of the marking has been done on the basis that those who use the rapid-transit system are natives of the city and familiar with its intricacies. Strangers are not given half a chance to use their own wits. New York, partly because the size of its transit systems gives it the greatest opportunity, is the worst offender. The stranger who seeks 42d St. is supposed to know that Times Square or Grand Central are its synonyms, and Pennsylvania that of 33d St. The uneducated man making his way into Long Island City must know that QVEENS really means QUEENS. Fortunate for him that no architect played a part in marking Union Square. As a further aid to the stranger, New York has two stations on the same system called Broadway. Boston, by the way, has a station called Lexington and another called Lexington Square. But while Boston has set a good example of what can be done in directional signs to advise the traveler as to what trains to take for specific destinations, much can be done there, as elsewhere, to improve the visibility of station names. Elimination of advertising signs which encroach upon station signs and the repetition of station names in small letters on all posts and blank walls is one thing that would help. The problem is not without its difficulties; yet if it were studied painstakingly from the traveler's viewpoint he could be saved many a delay and error, and be helped on toward his destination.

Safe or Economical?

WHERE does the subject of Mississippi River flood protection stand, now that the plan board has reported? No doubt the country at large believes that the decision to proceed with the execution of the Jadwin plan assures an end to the periodical flooding of the valley, and does so with due economy. It is timely to review the facts.

The plan is drawn for a flood which at Cairo would exceed that of 1927 by 25 per cent; at points downstream the margin of safety is not so great. No forecast was made of what rainfall or flood may visit the valley. It may be as well, for money enough to care for the ultimate does not exist, and man must recognize that the "act-of-God" type of storm is hardly to be reckoned with. Yet the truth is that the present project merely raises the high-water grade line by an arbitrary amount, as was done in 1922, in 1914 and on earlier occasions. Each of the former guesses at the extreme flood grade was soon surpassed by stern reality. Is there better ground for faith in the new guess? It is no more than a guess, at all events.

Levee heights are to be raised an average amount less than 3 ft., not even enough to provide for a flood of 1927 magnitude unrelieved by crevasses and quite inadequate to protect against the assumed flood of 25 per cent greater. Since the raising of levees will intensify the risk of disaster from overtopping, the levees are to be strengthened considerably. Even so, the levees will have to be watched and protected in every high water as now, and with their greater heights they may prove to be quite as vulnerable as are the present levees built for lower floods. At best levees are weak dams, and they have ever been at the mercy of saturation, percolation and slumping, not to mention the river's caving attack.

All excess flow beyond that which the new levee heights can accommodate is to go through diversion channels back in the low ground of the basins, each such channel being protected by its own levee lines. Though tremendously costly, the method is excellent in theory. But there is no present knowledge of whether and how it will work. The diversion channels are not actual channels but merely low areas of the natural ground, some of it densely timbered, and their flow capacity at any particular stage of slope is highly uncertain. Their bordering levees must be as safe as those of the river itself. Thus, four lines of levee will have to be maintained and protected instead of two—a serious addition to the difficulties of flood periods.

The diversion-channel areas are supposedly to be kept in use for agriculture and other present purposes. Since they will each year be in danger of sudden destruction, it is possible that few people will be willing to use them and that in effect they will be federal reservations. Probably most of the land will have to be bought up. This is even more obviously true of the riverbank channel opposite Cairo and of a large area at the junction of the two main diversion channels, where the waters diverted through the Tensas basin must flow to the Atchafalaya, and where backwater storage is contemplated as an essential feature of the flood-protection plan.

To divert the river flow into these channels when extreme high water approaches, low and weak head-levees are provided, these to wash out and discharge a sudden flood torrent into the diversion. This substitution of levees designed to give way for levees designed to

stand is a critical element of the hazard created in the regions below. Some of its weak points lie in the fact that no definite width of flow opening can be counted on, so that the amount of flood relief obtained is wholly subject to chance; that no specific legislative provision for repair is made; and that until a breach is closed all subsequent rises will flood the diversion channels at every overbank stage, thus precluding use of land in the floodway until repairs are made.

A bypass channel above New Orleans is to discharge into the bayous to the east all flood-flow beyond the safe capacity of the river channel past the city. This is the most certain and effective element in the entire river-protection plan. What silt deposition will take place in the river below and what its ultimate effect on the channell will be is still in controversy.

Extensive revetment of caving banks along the river channel is to be done, as an effort at stabilization. Present methods of revetting are of limited life and effectiveness, and no new method has been proposed in the plan to assure longer life or greater resistance against the overpowering tendency of the meandering channel to shift. For a long period of years the cutting of banks is sure to continue, and the levees at critical points will be in as much danger of breaching as hitherto. Until the problem of holding the channel has been solved, the valley will continue to be exposed to much the same danger from erosion as now.

No estimate of total cost has yet been made. The federal government assumed substantially all the cost, under the bill as passed by Congress. The conflicting figures of $296,000,000 (Jadwin; now raised by the plan board to $318,000,000) and $775,000,000 (commission) are known to be entirely inadequate to meet the provisions of this law. Figures of $1,000,000,000 and of $1,500,000,000 have been stated, speculatively, but nothing that can be called an estimate is yet at hand.

The total prospective value of the land which the system is designed to protect is hardly more than the original Jadwin estimate of cost, and very much less than any cost which includes land purchases or easements—and these latter, it should be observed, are omitted even from the plan board's revision of the figure stated in the report of the Chief of Engineers.

This brief outline sketches the enterprise in the physical elements. There remains to be added the statement that a great number of highly intricate and difficult questions of river hydraulics are yet to be studied, that the topography and values of the basin lands in so far as they may influence the works are unsurveyed, that no general economic survey has been made, from which might be set up a wise balance between expenditures and return, thereby separating good business from pure philanthropy and immediate money economy from ultimate countrywide development.

Control of the Mississippi River floods has passed quite definitely from a highly successful promotion stage into that of an engineering project. Politics and laymen are or should be through with it, except to pay the bills and reap such benefits as may arise. Distinctly from now on is the project in the lap of the engineering profession—made up of a quarter of a million civilian engineers and six hundred army engineers. In the latter group lies the administration of the work. The direction should endeavor to command without prejudice the best technical brains of both groups to give the valley a reasonable amount of protection and to guarantee the country at large, which is paying the cost, an economical and safe plan as well as an equitable distribution of its contribution toward the well-being of the great Central watershed. All of which means that before much of the work on new features is finally started additional engineering of a broad nature must be done, including surveys and research and deductions therefrom, with subsequent changes in plan as the facts may dictate.

Settle Out of Court

FOR years politics and selfishness have beclouded and delayed all development of the Colorado River. There has been (and still is) bitter conflict between the supporters of comprehensive river control aimed at in the Boulder dam project and those who oppose power development at a government dam; but still more bitter conflict has raged on the score of state rights. If this latter conflict, the crucial feature of the case, could be "settled out of court" by negotiation between the states this fall, development of the river could proceed.

As a straightforward business proposition the differences between the states of the basin could undoubtedly be composed if they were to be considered and judged fairly by an impartial body. But this happy result would require a wholesale sweeping away of prejudices and animosities—something well-nigh impossible now unless the matter could be put in the hands of an entirely new group of representatives who would approach the problem from a fresh and untrammeled viewpoint. To follow this plan, which has been suggested in some quarters, implies the dismissal of representatives who have accumulated many data about the Colorado River problem. That would be a drastic move indeed. On the other hand, if there is hope of avoiding an impasse, even drastic methods would be justifiable.

If the Swing-Johnson bill does not pass at the next session of Congress, none of the states involved will get what they want, and the whole Colorado River question will again be thrown open. It will be back at the starting point, to be worked and fought over for another long period before some new plan can be presented. If the bill does pass, with Arizona in her present frame of mind there is certain to be an appeal to the courts—a long-drawn-out affair that for years will prevent either state from getting what it wants and with the prospect for decisive outcome doubtful even in the ultimate closure of the case.

To the politician the prospect of long delay in settling the Colorado River question may be pleasing. It affords him excellent political capital. Witness the fact that in regions where interest in the matter is high even candidates for minor county and municipal offices are announcing their "policy" as to the development of the Colorado River.

The people of Arizona live closest to the problem and hear a great deal about it. Some of them, at least, are getting very tired of seeing the Colorado River "saved for Arizona." They would prefer to see some effective endeavor to reach a compromise agreement or a settlement on any reasonable plan that would end the long futile controversy and open the door for something constructive. Are the other states equally reasonable? Perhaps. The present—that is, the period intervening before the next session of Congress—is a golden opportunity for arbitration.

Photo courtesy American Aircraft Corporation, N.Y.

Fig. 1—Preliminary Design for Newark, N. J., Airport

Some of the Principles of Airport Planning

A Symposium of Opinion and Practice of Civil Engineers Who Are Directing Their Thoughts to Developing This Field of Activity

WITH THE IDEA of bringing together under one heading some of the leading current thought on airport planning, the following four articles are presented. P. A. Fellows, city engineer, Detroit, Mich., in a talk given in Detroit pointed out some of the possibilities for the civil engineer in this new field, and some of his views are here presented. John Nolen, consulting engineer, Cambridge, has for some time been devoting his attention to the problems connected with the selection of sites for airports, especially as a part of a city or regional planning program. His original article below gives a picture of the methods he is using to provide municipalities with the engineering consulting service that they need. Gavin Hadden, consulting engineer, New York City, published an article on airport planning in the magazine *Airports*, and parts of it are included below. E. P. Goodrich, consulting engineer, New York City, has written a comprehensive article for the National Municipal League entitled "Airports as a Factor in the City's Planning." While the article contained important detail as to the methods of intelligent prediction for the future of airports, the space available precludes mention of much of this. However, the article does set forth a number of broad general principles, and these are included below in abstract. The four articles taken together will show one method of placing airport selection on an engineering basis by the use of unit cost analysis, will provide a picture of the necessary physical units required in an airport and will exemplify some of the factors that are involved in laying out an airport and tying it into the city and regional plan.

—EDITOR.

A New Field for Engineering

BY P. A. FELLOWS
City Engineer, Detroit, Mich.

THE recent rapid development of general interest in aviation has brought to the front a new field for engineering. Development of the airplane has already reached a stage where the limit of its usefulness seems fixed only by the places which may be provided for taking off and landing. Money totaling an immense sum has already been provided for airplane terminal facilities. But because of the newness of the problem not every one on whom the responsibility rests recognizes the fact that the selection of the proper site for an airport is just as much an engineering problem as are its design and construction.

In comparing various sites for airport purposes, it seems that the reasonable thing to do would be to reduce them all to a common level on a basis of money, as far as that is possible. Such a relative cost would include, of course, the price to be paid for the land. To this would be added the engineer's estimate of the cost of such improvements as are contemplated, which would include clearing, grubbing, grading and such construction as may be warranted. A third item would include cost estimates for the construction necessary to put the fields on a comparable basis, even though such construction may not at that time be contemplated.

An illustration of the latter factor would occur in the case of a field subject to overflow, which it may be necessary to compare with a field which is not subject to overflow and which in other respects is equally desirable except for a difference in price. In order to put the fields on the same basis, it would be possible to build dikes around the field which is subject to overflow and thus reproduce the conditions in the other. To the cost of the field subject to flooding should then be added the estimated cost of the dikes. This does not mean that the dikes would be built at once, or at any time, for that matter; but it would place the estimates on a comparable basis. In another case the property under consideration might be traversed by a deep ditch or small stream. If this is to be compared with a site which has no such obstructions, then an estimate should be made of the cost of inclosing the stream in a culvert and filling the depression over the culvert to the general level of the surrounding land; or it might be advisable, on analysis, to divert the stream to lines lying along the boundaries and leave it uncovered. Even after all such features are taken care of, there still remain many items which cannot be reduced to a money cost basis, and we may have several airport sites to consider which have varying degrees of suitability at various total costs.

If this suitability could be set up in terms of percentages of perfection or other comparative units, then these total costs could be reduced to a comparative cost basis by the simple process of dividing the total cost of each field by its total number of units of suitability. The field having the lowest comparative cost would then presumably be the field that would demand the most serious consideration. Even though such an analysis might not finally determine the selection, it would afford a valuable guide.

The units of suitability could be more easily fixed by outlining the various factors that go to make up the desirable field. In such an analysis it is necessary to take into consideration the general accessibility of the field and the meteorological conditions surrounding it, as well as its size, shape and topography. It is not conceivable that these factors would have the same value in all locations, or that even the same factors would apply to every municipality. It was brought out at a recent aeronautical conference that a field might very properly be a different shape in a location where the winds were always from a given direction than would be desirable for a field where the winds were constantly varying; a larger sized field is more valuable in a location with a high altitude than it is in a location with a low altitude, etc.

In the following tables no particular location is kept in mind and values are arbitrarily assigned to illustrate what might be termed an engineering analysis of the whole question. The items of suitability are grouped under two heads, one of which might be called the operation value and the other the location value:

Items of Operation Value	Relative Value
Freedom from dense river fogs	8
Freedom from ground mist	5
Freedom from smoke conditions	6
Freedom from snowdrifts	1
Freedom from air travel interference	4
Prospective neighborhood development	2
Area of field	8
Configuration of field	4
Freedom from objectionable air currents and eddies	1
Approaches—Satisfactory areas under take-offs	3
Favorable prevailing winds with reference to runways	4
Other factors affecting safety	4
Total units	50

Items of Location Value	Relative Value
Location with respect to the axis of air travel	8
Distance and direction from the source of air travel business	7
Distance from the geographical center	4
Distance from center of population	8
Distance from rail terminals	2
Distance from water terminals	1
Distance from post office	6
Distance from hotel center	5
Distance from economic center	3
Distance from financial center	3
Distance from center of airplane manufacturing industries	3
Total units	50

The total number of suitability units would be 100,

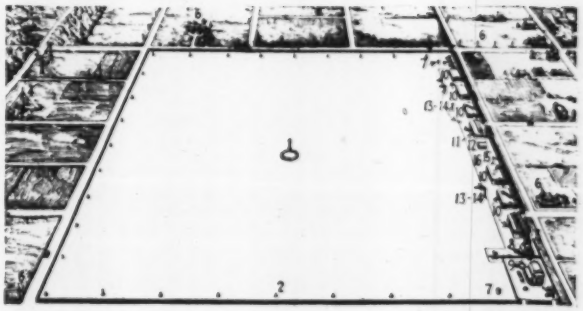

FIG. 3—THE IDEAL AAA AIRPORT OF THE DEPARTMENT OF COMMERCE

1—Circle marker. 2—Boundary lights. 3—Rotating beacon light. 4—Radiobeacon with flashing red obstruction light. 5—Radiotelephone with flashing red obstruction light. 6—Flashing red obstruction lights on power and telegraph lines, houses, etc. 7—Floodlights for landing. 8—Administration building. 9—Clubhouse. 10—Hangars, floodlighted. 11—Shop, floodlighted. 12—Fire department. 13—Underground fuel tanks. 14—Fuel outlets. 15—Wind indicator (illuminated). 16—Concrete apron.

equally divided between the two headings. If one field measured on this basis had only 50 units and had an estimated total cost of $800,000, the comparative cost would be $16,000. If another field had 80 units of desirability and its total cost was $1,000,000, the comparative cost would be $12,500. Such a comparison would be a material aid and possibly a determining element in the selection as between any two such locations.

In order to illustrate how the various items might be evaluated, consider the item "Distance from the axis of air travel." In some locations such an axis can be very definitely located. If it is assumed that the field which lies directly on this axis is to be given maximum value, according to the above table this would be 8. Assuming that the least desirable field, so far as this item is concerned, would be located in the most remote corner of the country or district 20 miles from the line of air travel, a field 5 miles from this axis then should be given a value of 6: $[(20 - 5) \div 20] \times 8 = 6$.

Another illustration would be in the case of "Satisfactory area under the take-offs," or what might be designated as clear approaches. The ideal field would have approaches from all directions, but one that is almost as well suited has approaches from each direction of the diagonals, as well as from the points midway between the diagonals of the square field. This means that such a field has eight clear approaches converging at angles of about 45 deg. If the field under consideration has two of these approaches blocked by factories with high stacks or by high-tension lines which cannot be relocated, and if the value set up for these approaches

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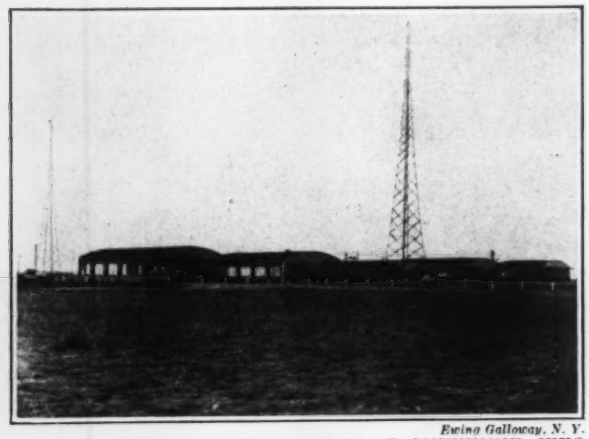
FIG. 2—FLOODLIGHTING FOR NIGHT AIR MAIL AT HADLEY FIELD, NEW BRUNSWICK, N. J.



Ewing Galloway, N. Y.

FIG. 4—A CORNER OF THE FIELD AT CHEYENNE, WYO. Showing radio towers, wind indicator and lighting equipment.

is 3 as given in the table, then the value of the item for the particular field under consideration should be $[(8 - 2) \div 8] \times 3 = 2\frac{1}{4}$.

In the case of fog or smoke obscuring the field, the relative value can be determined if the number of days of obscuration is known in each case or can be approximated. The total time in a year which the approaches would be clear, divided by the total days in the year and multiplied by the relative value in the table, gives the modified value.

The distance from the various centers can be evaluated in a similar way, provided some standard of desirability is set up. This standard of desirability might be fixed at fifteen minutes. The variation in this factor would not materially affect the comparison, because so many other items enter into the consideration, but its effect on the field is relatively the same by assuming that fifteen minutes is selected as the standard time for reaching the field from one of the centers. Then that standard time divided by the actual time taken to reach the field under consideration and this in turn multiplied by the relative value set up in the table will give a comparative figure.

When these items are all considered on this basis and the total cost determined for each field, that total can be reduced as indicated to a comparative unit cost. Such a method might be helpful in almost any case where the selection of an airport is under consideration. To the extent that such a method of evaluation is used, engineering analysis is substituted for guesswork and sound reasoning advanced to support the final selection.

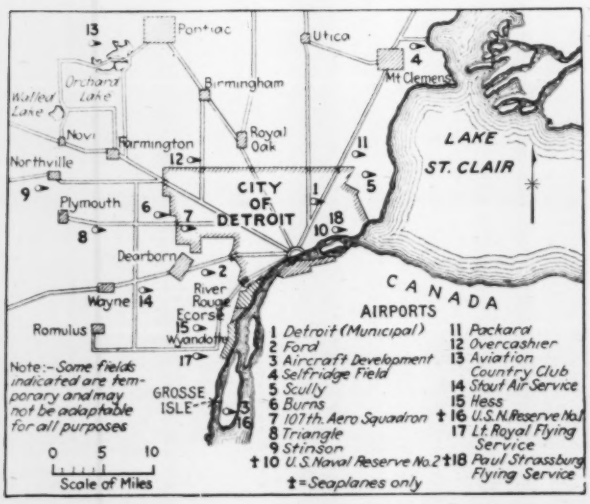


FIG. 5—PUBLIC AND PRIVATE LANDING FIELDS NEAR DETROIT, MICH.

* * * *

Airport Qualifications

By John Nolen
Consulting Engineer, Cambridge, Mass.

For some time we have been particularly interested in problems connected with the selection of sites for airports and their layout, especially as a part of a city or regional planning program. More and more cities are asking for guidance, and we have drafted the accompanying questionnaire of site qualifications which has proved valuable to them as well as to us in compiling the fundamental data that are necessary for a preliminary plan. As a corollary to this questionnaire we have also prepared an outline giving in brief the requirements for a triple-A airport.

The term "airport," according to the air commerce act of 1926, means any locality, either of water or land, which is adapted for the landing and take-off of aircraft, or a place used regularly for receiving and discharging passengers or cargo by air. Basic requirements for a certificated airport as laid down by the Department of Commerce regulations include a suitable field, well drained, with at least two landing strips 100 or more feet wide, crossing or converging at angles of not less than 45 deg., free from obstructions, situated near a good highway adjacent to the nearest town, equipped with a wind indicator and markers and with provisions for fuel, communication, transportation and personnel. Landing fields receiving a triple-A rating must have in addition to these facilities one or more hangars, repair facilities, a waiting and rest room, restaurant, sleeping quarters for at least three persons in addition to the field personnel, fire-fighting and first-aid equipment, ground signal devices, weather service, register of arriving and departing aircraft and an unobstructed landing area in all directions of at least 2,500 ft., equipped with the latest night flying facilities. In Fig. 3 is given a layout of such an airport as is contemplated by these regulations.

Based on the requirements for a triple-A airport, the following outline will give engineers some idea of what is necessary:

Area Required—Minimum approximately 150 acres.

Shape—Square, rectangular, L shape, T shape, circular or irregular, as dictated by the land available.

Dimensions—Length, width or diameter should be ample to provide a minimum runway length of 2,500 ft.

Landing Areas—Preferably the entire field should be available for landing. If this is impracticable, landing strips should be constructed for at least four-way landings and if possible for eight-way landings.

Field Grade—Preferably as near level as possible to provide drainage, but with maximum grade of 2 deg.

Field Surface—Heavy turf or sod. The Department of Agriculture has made up special formulas for grass mixture suitable to various sections of the country.

Drainage—Good surface drainage imperative. Tile underdrainage should be installed when soil is impervious.

Boundaries—Limits of field should show clearly during the day and be illuminated by boundary lights at night.

Approaches—Aerial approaches should be clear. Vertical obstructions require 7 ft. horizontal distance for each foot of height.

Landing Strips and Runways—If it is impracticable to grade or use the entire area of the field, landing strips 300 ft. wide with center runways 100 ft. wide should be constructed. The runways must be surfaced to make them serviceable in all weather.

Buildings—These will vary according to the intensity of use of the airport, but necessary buildings should include hangars, repair shops, storehouses, garages, an administration building, embarkation and debarkation buildings, with restaurant, waiting and rest rooms, sleeping quarters for pilots and employees and first-aid stations and a fire station.

Motor Car Parking—Make ample provision for the visiting public.

Utilities—Water supply, sewage disposal, light and power are necessary. All light and power lines should be installed underground.

Equipment for Service—Pumps and storage for fuel and oil, water and air.

Markings—Standard circular marker (100 ft. diameter) showing name of city or field, runway markers and orientation arrow (true north) are necessary. All vertical obstructions should be so marked that they are clearly discernible. A day ground signal system is necessary for communication between aircraft and airport.

Meteorological Equipment—Wind indicator clearly visible from over all parts of the field, anemometer, barometer, thermometer, weather map and bulletin board comprise the essential equipment. Close affiliation with the nearest weather bureau is absolutely necessary.

Night Lighting System—To operate effectively and safely at night the airport should have the following equipment: Airport beacon; illuminated wind direction indicator or cone; boundary lights about field; floodlights for illuminating field and buildings; signal lights; ceiling projector, for determining height of clouds, etc.; auxiliary lights—for obstructions use red; for major obstructions use flashing red; and for approach lights use green.

Communication System—The poles and masts for the telephone, telegraph and radio systems should be located out of lanes of approach.

A mooring mast for dirigibles and seaplane facilities are factors which may have to be considered under some circumstances.

Ownership—The federal government is prohibited by law from owning and operating commercial airports, but is charged with the responsibility of lighting the airways of the country, in a manner somewhat parallel to its responsibility in regard to marine navigation. The situation of airports is again somewhat parallel to that of the seaport in which the local port authority exercises control. It would seem logical that the ownership and administration of the airport might very well be a function of the municipal governments, although there will naturally be privately owned fields. The transportation companies then would be relieved of the necessity of heavy ground expenditure. Especially is this desirable in the United States, where the principle of the subsidy is not employed. The use of the airport and its equipment then would be available to all airlines, thus creating a common terminal in the city and avoiding the great loss of time that follows in the wake of transfer from one line to another if at separated terminals. Uniform charges should be made for the use of facilities on a scale that would encourage development but so adjusted as to make the airport self-supporting. In many places provision should be made for airplane industries in connection with the airport.

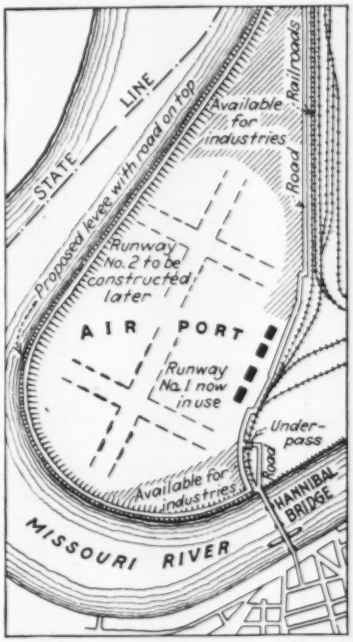


FIG. 6—PLAN OF THE KANSAS CITY MUNICIPAL AIRPORT
Voters recently approved a $1,000,000 bond issue to insure development.

Cost—There is as yet little available in the way of reliable cost data on airports. Until the aeronautics branch of the Department of Commerce was established and set up standards of design and equipment, there was a large amount of variance in the flying fields and their facilities. Sixty-eight flying fields on the contract air

SITE QUALIFICATIONS FOR AIRPORT

AN OUTLINE FOR SECURING NECESSARY ENGINEERING DATA FOR AIRPORT SELECTION

1. Name of Tract.....
2. Location.
   - *a.* General location (if possible show by a key map).....
   - *b.* Direction from center of city (city hall).....
   - *c.* Distance from post office, in miles..... in minutes by automobile.....
   - *d.* Highway connections, type of paving and condition.....
   - *e.* Transportation facilities, electric line, bus, railroad.....
   - *f.* Character of neighborhood, present and probable future use.....
3. Description (to be accompanied by a survey—topographical preferred).
   - *a.* Area in acres.....
   - *b.* Shape.....
   - *c.* Main dimensions in feet.....
   - *d.* Orientation of longest dimension.....
   - *e.* Cleared or wooded.....
   - *f.* Surface soil.....
   - *g.* Subsoil.....
   - *h.* Drainage conditions.....
   - *i.* Distance from nearest water supply.....
   - *j.* General character of topography.....
   - *k.* Elevation above sea level.....
4. Meteorological Data.
   - *a.* Prevailing winds.....; annual.....; winter.....; summer.....
   - *b.* Direction of heaviest winds, months and highest recorded velocity.....
   - *c.* Fog conditions: months of greatest frequency..... days per month.....; time of daily occurrence and hours of duration.....
   - *d.* Precipitation: average annual amount.....; months of greatest fall.....
5. Physical Obstruction on the Tract (shown on survey, if possible).
   - *a.* Buildings.....
   - *b.* Trees and undergrowth.....
   - *c.* Pole lines.....
   - *d.* Traveled roads.....
   - *e.* Streams.....
6. Obstructions on Adjacent Property.
   - *a.* Hills and mountains, distance from tract.....
   - *b.* Forests or woods.....
   - *c.* Buildings.....
   - *d.* Pole lines.....
   - *e.* Railroads or electric lines.....
   - *f.* Traveled roads.....
   - *g.* Streams.....
7. Owners of Tract.....
8. Cost Price.....
9. Expansion: directions, acreage generally available and approximate cost per acre of adjacent land.....

Information Furnished by.....
Address.....
.....
Date....., 1928.

mail routes represent an aggregate investment of $17,000,000, or an average cost of $210,415 per field and $47,000 for improvements.

* * * *

Airport Planning

By Gavin Hadden
Civil Engineer, New York City

IT IS often said that "in the next few years the city without an airport will be as much behind the times as the one without a railroad station." This statement may be literally true. Probably, with a suitable definition of the word "few," it is. Some of the implications which it may carry, however, are not true.

Those familiar with the development of the railroads in this country will be led by this statement, consciously or unconsciously, to recall those communities which failed to be included in some important railroad system and thus later saw much of the trade and commerce rightfully theirs attracted by some rival city. They may fear that the same fate will be theirs if they are "left out" in the development of air transportation, and thus may rush pell mell into the establishment of costly and ill-planned facilities which may later prove a handicap.

While quick and immediate action was often necessary when a railroad was projected, this is not strictly the case with air transportation. Air routes may be altered almost overnight and no costly right-of-way and roadbed need be constructed across miles of territory beyond the limits and beyond the influence or control of the city concerned. In this respect air transportation differs also from motor transportation with its paved roads and rights-of-way and, in a lesser degree, from water transportation, with its channels and waterways. The location of intermediate landing fields and route markers is about the only outside physical consideration that may influence the direction of air routes.

The sound policy, therefore, since hurried action is seldom necessary, would seem to be not to plan merely for the needs of the moment nor to build immediately for some great future hope, but rather to do the reverse: To plan for future developments as nearly as they can be predicted, and to build for the immediate needs.

The first and most important consideration in planning an airport is usually its location. Those who have had experience with important construction projects, and particularly with those similar projects upon which the physical conditions of the site have so material and important a bearing, realize that the most advantageous design for a given site must be pretty generally determined before a sound decision for or against that site can be made. In other words, the general design of the airport should be to a large extent determined before rather than after its location has been definitely fixed.

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FIG. 8—AIR MAIL FIELD AT McKEESPORT, PA.

Furthermore, an "ideal airport" design, while useful for general guidance in illustrating some of the proved principles, can hardly be applied directly or exactly to any site. Furthermore, a design agreed upon today as "ideal"—if agreement could be reached—might well be completely out of date next month.

It is possible, however, to name the principal considerations which are in one way or another likely to influence every problem, and these are herein set forth with brief comments. Further influences are indicated only where future predictions are likely to be particularly useful.

Considerations Influencing Airport Design—The use to which the airport will be put influences the design. Some of these uses are as follows: Military or civil; land or sea plane traffic; lighter-than-air craft; daily service and night service; passenger service; cargo service; express and local services; special services; exhibition service.

The size and the shape of the area also affect the design. This is almost entirely dependent now upon the required lengths, widths and directions of take-off runways and landing strips, since the quantity of traffic

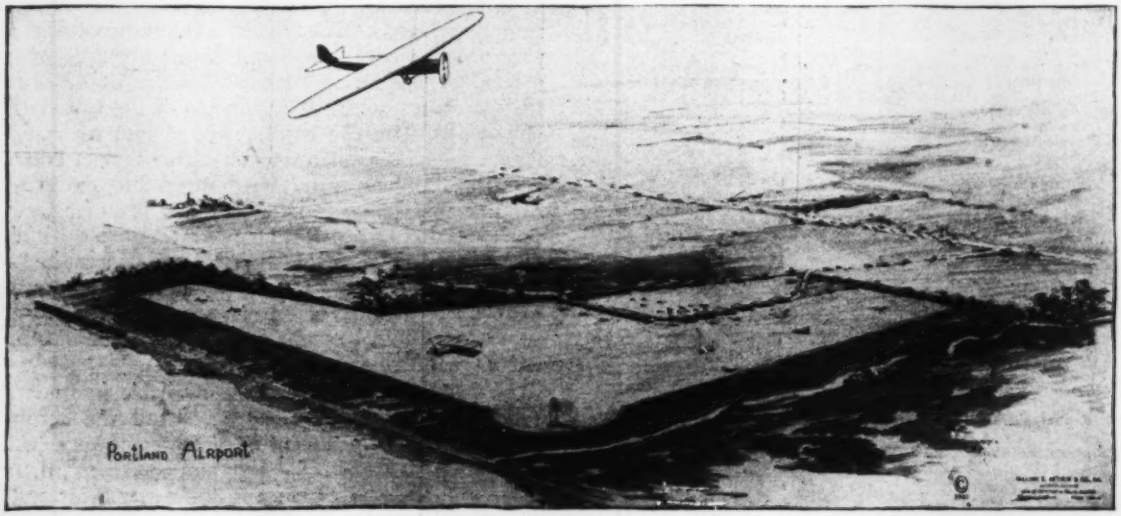

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FIG. 7—THE AIRPORT AT PORTLAND, ME.

has not yet had an appreciable influence. The factor of accessibility is also a vital consideration in airport design and includes: Unobstructed approaches; control of or zoning restriction of surrounding areas; and ease of finding the landing field from the air. These refer to accessibility for the aircraft. There is also the question of accessibility for passengers and cargo, which is likely to become more and more important as air commerce increases. A fourth factor in airport design is land value, which is likely to be the largest single item of cost in building an airport. The surroundings, meteorology, topography and drainage are also important factors to be considered in the design. Lastly, the many details that make up an airport—type of surface, kind and number of such auxiliaries as wind direction markers, beacons and communication systems, and kind and number of such service facilities as repair shops, hangars, living quarters, rest rooms and office buildings—have their influence on the final design.

* * * *

Airports as a Factor in City Planning

By E. P. Goodrich
Consulting Engineer, New York City

THE characteristics of air travel place it in the same general class with railroads and water carriers in that special terminal arrangements must be provided. An air terminal must usually be placed in the open country, but, like terminals of other varieties, it should be located as close as possible to the business center of the community to be served. Croydon is about 10 miles from Trafalgar Square, London; Le Bourget is 7 miles from the center of Paris; Tempelhof is 3 miles from the heart of Berlin.

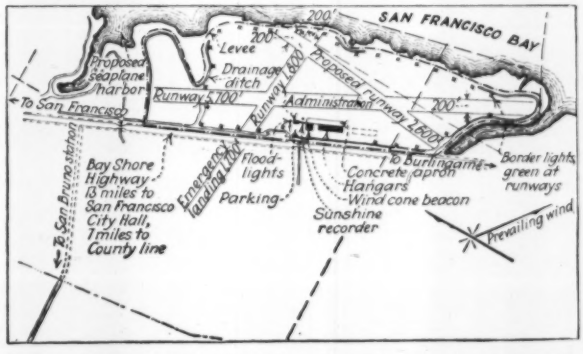

FIG. 9—MILLS FIELD, SAN FRANCISCO'S MUNICIPAL AIRPORT, WILL ULTIMATELY COVER 980 ACRES

The landing fields in New Jersey and on Long Island are so far from the hotels in Manhattan that lately it took as long to motor from one of them to New York as it had taken to fly from Boston. The Cleveland municipal field is 9½ miles from the public square (air-line distance)—about 30 minutes by auto and conceivably about twelve minutes by train. That it is undesirable to locate a field at any considerable distance from the business center is indicated from the report that one European city abandoned an outlying airport and created one relatively close to the center by razing several blocks of buildings.

Ample Means of Access—As in the case of all other terminals, ample means of access must be provided for conveyances of other types between which and the air carrier transfer of passengers and property must be made. Also, because air transportation is new, extra facilities must be provided at air terminals for spectators, and highways, street railways and even steam railroad connections must be provided to transport the people. Highways should be provided from the field in as many directions as possible and sufficient in capacity to carry away all the automobiles of all the inhabitants of the surrounding territory for a radius of at least 50 miles within a period of perhaps three hours. In addition, the problem of parking space for the motors and sidings for the storage of trolley and steam equipment is of importance.

Incidentally, while transportation accessibility is of great moment in locating an airport, its creation should be such as to hamper transportation as little as possible to

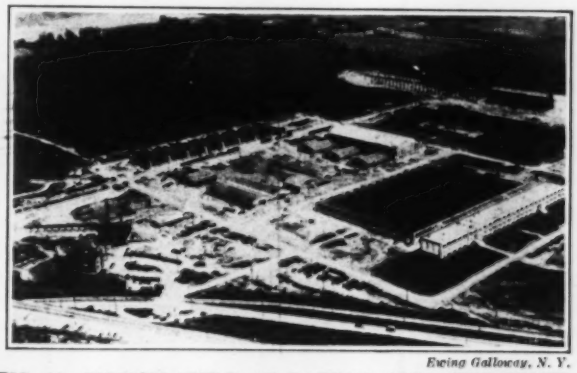

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FIG. 10—WRIGHT FIELD AT DAYTON, OHIO, THE BIRTHPLACE OF THE AMERICAN AIRCRAFT INDUSTRY
Airplane builders must locate near a landing field. The large building in the right background is a wind tunnel for testing wing design.

points beyond it. The area required for a large flying field will generally overlap one or more major thoroughfares which would consequently have to be closed. Such closings should be obviated if possible. It is sometimes possible to select a site which is adequate for immediate needs and which can be enlarged progressively by being used as the community refuse-disposal site. It is hardly to be expected that regular traffic will ever reach such figures as are now being attained while aviation is a novelty. Plans adequate for the present may, therefore, be expected to be ample for the future.

Emergency Fields — Numerous emergency landing fields should be arranged, especially in fairly well-settled territory like the suburbs of cities. Each of these should have an area of about ten acres and around cities should be spaced throughout the whole area, at the corners of 5-mile squares, or approximately so. Fields for emergency use only may be cultivated with any crop that does not grow too high.

Area Requirements—Fields now in active use vary all the way from 1,000 acres (Mitchell Field, Long Island) and 700 acres (Cleveland) down to 40 (Boston and Pittsburgh), with 25 acres considered the smallest feasible size for landing except in cases of emergency.

The area required for a field will largely depend upon the amount of use to which it will be put and, to a considerable measure, upon the development of aircraft. If a large number of planes are to use the field, it may be necessary to use different parts for arrival and departure, respectively, and to control the arrivals and departures by a signal system operated by a despatcher, as is done at Tempelhof (Berlin). The loading and unloading accommodations could then be placed advantageously at the center of the field, arrivals approaching this center from one direction (against the wind) and departures

taking place on the opposite side of the loading and control station (again into the wind).

From a topographic standpoint it is now generally felt desirable to secure large level areas for landing fields. To reduce approach hazards to a minimum, these fields should be chosen as far as possible on hilltops or high ground, where ground haze is usually at a minimum. Although islands possess advantages as to levelness, freedom from approach obstructions and complete liberty in direction of approach, they are more apt to be affected by fog than mainland locations. Wherever seaplanes can be employed on a route in any direction from a port while land machines operate over other routes, a combined water and land port is considered desirable.

The soil must be such as to produce a thick, tenacious sod, and where this is not obtainable, concrete, asphalt, macadam or cinder surfaces must be provided. It is generally conceded that when an airplane lands it strikes the ground with a blow equal to perhaps five times its dead weight.

At sea level the length of the field, at least in the direction of the prevailing winds, should be not less than 2,500 ft., plus 7 ft. for each foot of height of obstructions at and beyond the boundaries of the field at each end. For altitudes above sea level, longer runways are required. Large seaplanes require as much as 3,500 ft. clear run unobstructed by such things as bridges, breakwaters or buoys and also require at least 6 ft. of water depth.

Unless the surfacing of airports is such as to minimize the dust, the hangars should be placed at the side of the field at right angles to the prevailing winds. With a large field in which the hangars are to be at the center, it would be advantageous to have the parked airplanes housed below the surface to guard their bearings from dust.

Open spaces available for eventual airfields should be acquired and set aside in each community and employed as recreation bases, athletic fields, parks, etc., until they are required for aeronautics. Meantime, if invention eliminates the necessity of such long landing and take-off runways, the open space will continue to serve a legitimate purpose.

Texas Starts Sewage Research Work

Sewage research work is now under way at the Sewage Research Laboratory of the Texas Engineering Experiment Station, which is situated at the Agricultural and Mechanical College of Texas. Various research projects will be carried out that should be of value in solving the sewage-disposal problems of Texas and the Southwest. These projects include studies of stream pollution, the action of the Dunbar filter, use of sludge as fertilizer, irrigation with plant effluents and separate sludge digestion. To aid the work of the laboratory the two sewage-disposal plants of the college are being remodeled.

The work will be under the general direction of F. E. Giesecke, director of the Engineering Experiment Station, and E. W. Steel, professor of municipal and sanitary engineering. P. J. A. Zeller, who was for three years a chemist at the New Jersey Sewage Experiment Station, has been appointed research associate. In the studies of sludge utilization assistance will be given by the personnel of the Agricultural Experiment Station, which is also located at the Agricultural and Mechanical College.

Roller and Sector Gates on Hydro Plants in Norway

Design and Operation at Typical Plants—Water Economy in Passing Logs and Cold Weather Operation Are Factors

By Oren Reed

Assistant Designing Engineer, San Joaquin Light & Power Corporation, Fresno, Calif.

ENGINEERS in Norway and Sweden have had extensive experience in constructing hydro-electric plants to operate under very severe conditions, and details of design and construction developed there, particularly in spillway gate practice, have become of increasing interest to American engineers as more and more projects are built in high altitudes and cold climates in this country. In the course of a trip of more than a year in 1922-23, the writer visited the major hydro-electric plants in Norway, to study hydro-electric practice there and compare it with that in vogue in America. Chief features of the observations and conclusions made on that trip are reviewed in the following:

The water supply for the high-head plants in central and western Norway is drawn from large mountain lakes. Capacity is increased and the outflow regulated by small masonry or rock-crib dams. Spillway problems are usually of minor importance, because the storage capacity is large in comparison with the runoff from the tributary area. Needle dams and Stoney gates are used for regulation in the spillway to increase the storage as much as possible.

In southeastern Norway the streams have a moderate gradient and a relatively large flow. The characteristic feature of these rivers, the Glommen, Skien and Numedalslaagen, is their long sections of swift flowing water with many rapids, followed by a section where one or more natural lakes are formed, after which the flow continues through another narrow passage with many rapids and falls. The chief industrial area of Norway is around the Kristianiafjord and the water-power resources on the near-by streams have been rapidly developed in recent years.

Due to location and flow conditions, the Glommen River was the most favorable for development, and the lower course of this river is nearly entirely utilized. In the middle course of the stream there is a large lake, Mjosen. The outlet of this lake has been regulated since 1916 to give a minimum flow, in the winter, of 700 sec.-ft. The two chief problems in the operation of hydro-electric plants on Norwegian rivers, as the Glommen, are ice trouble and of passing logs past the plant. Evolution in spillway design to take care of these conditions has led to the adoption of roller or sector gates, or a combination of the two types, for flood and service regulation at all new plants. Another important requirement fulfilled by these gates is that of water-tightness. The flow is lowest in winter when power is most valuable and waste of water cannot be allowed.

The lumber industry has been one of the chief means of livelihood in Norway for many years. The logs are cut and hauled to the streams in winter to be carried by the spring floods down to the paper mills and sawmills near the seacoast. In a normal year six to seven million logs are floated down the Glommen.

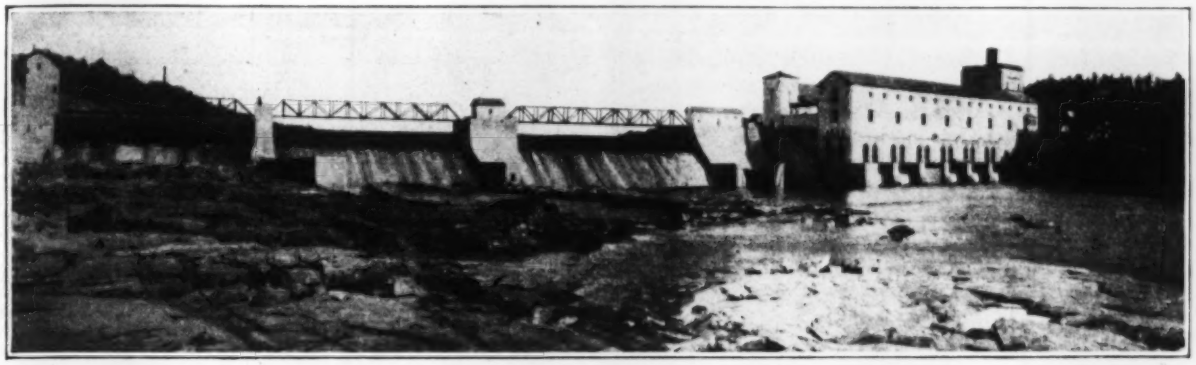


FIG. 1—RAANAASFOS POWER-HOUSE AND DAM, NORWAY
Six horizontal reaction units are installed in the power house. Each has a capacity of 12,000 kva., average head 46 ft., electrical apparatus indoors. There is a log-run in tunnel to left of roller gate.

At the earlier plants, as at Hafslund and Kykkelsrud, a simple method of regulation was adopted. The crest of a fall was leveled up by a broad masonry dam, upon which a needle dam was erected. The flow was led by a long head-race to the power house. Much trouble was experienced each winter from block and needle ice. In some cases, as at Lienfos, an open or free-fall spillway was constructed. This type of plant had little ice trouble, for the water was drawn from a large forebay pond which was frozen over in the early fall. When the stream was more fully utilized, close regulation of the forebay ponds was necessary at all seasons of the year and sector and roller gates came into use, as at Raanaasfos, Solbergfos and Vamma. These three plants are typical of modern practice in Norway and the spillway structures and gates will be described more fully in the following.

Raanaasfos—The Raanaasfos plant was completed in 1922. The dam is a concrete gravity structure, 590 ft. in length. The concrete is faced with granite blocks on the piers and spillway crest. The spillway has a capacity of 141,000 sec.-ft. and is regulated by two sector gates and one roller weir.

Each of the sector gates has a length of 164 ft., with a regulating height of 12.3 ft. These gates form the usual passage for the timber run. The pier between the two gates is 40 ft. wide and contains the operating apparatus. Experience has shown that logs do not lodge against a wide, blunt pier, because of the surface current which forces the logs to either side.

Sector gates were selected for use at Raanaasfos in spite of the fact that there was only one other installation of these gates in service in Europe (Weser dam at Bremen, Germany). This is the only type of gate which gives a completely open crest for the spill and at the same time is easy to operate. The construction is such that the gates may quickly be fully opened and closed (it requires about three minutes to operate a gate through its full height), so that logs may be passed which have collected above the dam and use the least possible water in the low runoff season.

Since sector gates had not been operated in extremely cold climates, provision was made for taking the gates entirely out of service in winter by means of a needle dam in front of the sectors. It has been found that the needle dam was not necessary and it is used only when the sector gates are to be inspected.

The body of the sector is constructed of steel plates stiffened by a cross-framing of angle iron (see Fig. 3). The plates of the shell are fastened together by inside butt-straps and rivets which are countersunk on the outside, giving a smooth outer surface. The overfall surface is covered with oak planks. The total weight of each sector with its plank covering is 232 tons.

In order to obtain definite regulation of the pressure in the body of the sector, the shell must be tight. Clearances are made as small as possible and end and edge seals of flexible bronze strips are provided. Leakage from the gates is very small.

In the end piers, as well as in the center pier, there are bulkheads in the steel plate which forms the end of the sector pit. When the pit is dry and the gate is locked in its highest position, the pit may be entered through the bulkheads for inspection.

The position of the sector is determined by the water pressure inside the sector body. Reservoir pressure is applied by suitable valves and piping. The gate will remain in any position at which the control apparatus has been set. When in the full-open position the gate may be locked. In addition, compressed air is used when increased pressure is required. The use of compressed air is necessary in case the reservoir level drops below the sector pit and it is desirable to raise the sector. The compressor is in the center pier. Compressed air is not used for normal operation but only as a reserve.

After the first winter's operation the needle dam has not been used. The sectors are locked in their highest position at the beginning of winter, after making certain that the seals are in good order. The sectors form stiff units and there is no tendency to jam. The compressor plant could no doubt be omitted. No attempt is made to

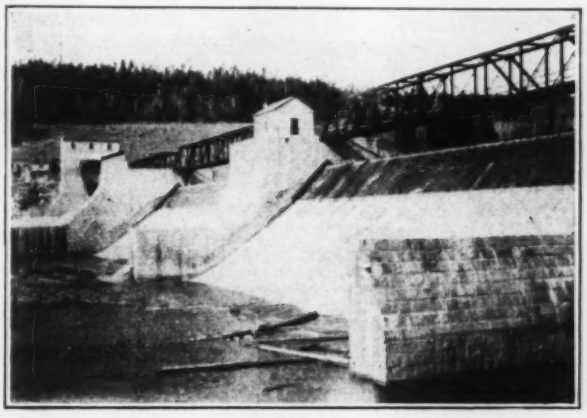


FIG. 2—SECTOR GATES IN CLOSED POSITION AT RAANAASFOS
Dark, upper portion of each spillway is downstream face of the steel sector, which can be lowered into the dam by mechanism in center pier.

operate the sectors in winter, although winter operation is not impossible. Similar sectors at the Weser dam at Bremen have been operated without difficulty during long periods when the temperature was as low as —4 deg. F. The passage of logs over the sectors has been very satisfactory and has done no damage other than tearing off some of the plank decking. It has not been necessary to renew the seals.

The roller gate, which was constructed for the third spillway opening, is used for regulation in winter as well as during the flood season. It has a length of 147.5 ft. and a regulating height of 21.3 ft.

The gate has the form of a cylinder 16.4 ft. in diameter provided with an extension on the under side which gives a 21.3-ft. weir. The cylindrical part of the gate consists of steel plates which are stiffened internally by ribs of plate and angle iron. The greatest plate thickness (at the middle of the cylinder) is 1.1 in. The lip extension, which is covered with steel plate, is fastened to and supported on the cylinder by angle-iron saddles. Along the lower edge of the lip extension there is an oak seal strip. When the gate is in the lowered position this seal makes contact with an I-beam fitted into the concrete of the dam.

The cylindrical part of the gate is provided with gear teeth at each end which mesh with toothed inclines fitted in the piers. At the right end of the gate there is a heavy lifting chain for operation. The gear train is driven by a 40-hp. electric motor through a clutch. The 273-ton roller can be raised from its lowest position in 30 minutes. Hand operation can be employed in case no current is available. A chain is fastened to the end of the gate which is not driven. This is anchored at the top of the pier to prevent the gate from falling in case the teeth should come out of mesh.

There are steel plates on each pier against which the timberclad, flexible tightening plates bear. Electrical heating elements are installed in a recess back of the end plates. The heating elements have a capacity of about 60 kw. and have been sufficient to keep the gate ready for operation at all times.

Solbergfos—The plant at Solbergfos was completed in 1924. (*Engineering News-Record*, July 24, 1924, p. 143.) The dam is a gravity structure of concrete and the length measured along the crest is 174 ft. Piers and spillway have a facing of granite blocks. The water level in the forebay pond is at the same elevation as Lake Oieren, which is 3 miles upstream. The outflow from Lake Oieren will be regulated by Solbergfos dam to give a constant flow during the low-water season. The power house is parallel to the river and its upstream end forms one abutment of the dam. The substructure of the power house was finished for the full installation of thirteen units, but only seven units are now in place. The vertical reaction units take water from an open forebay and discharge into the river just below the dam.

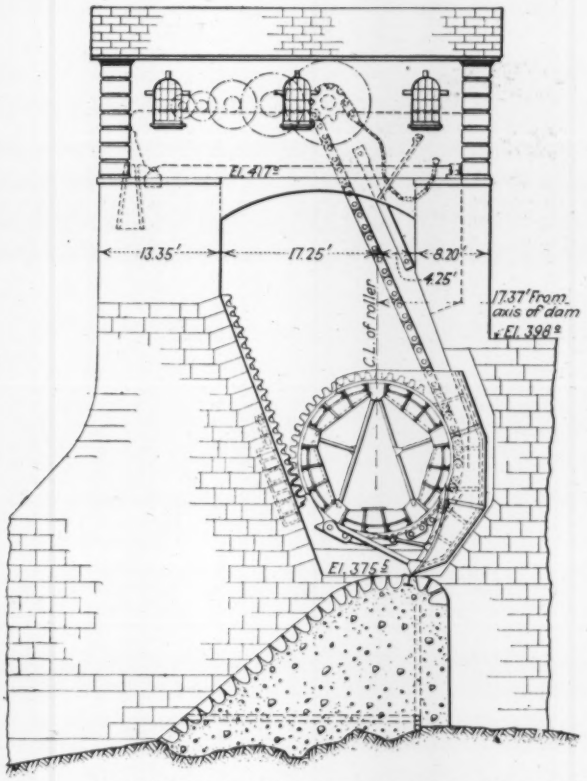


FIG. 4—CROSS-SECTION OF ROLLER GATE AT RAANAASFOS

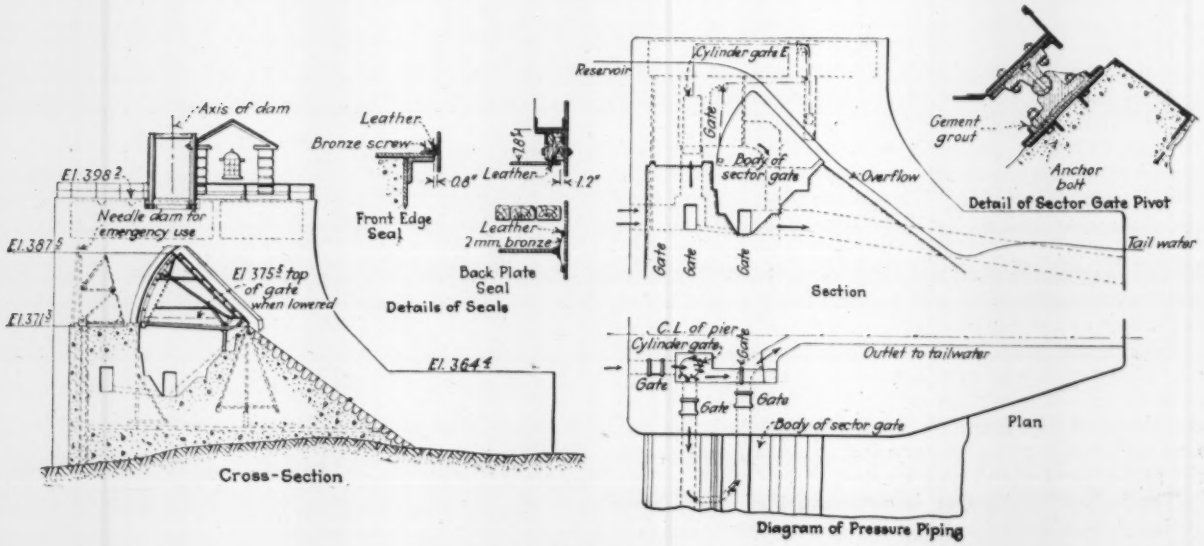


FIG. 1—CROSS-SECTION AND DETAILS OF SECTOR GATES AT RAANAASFOS

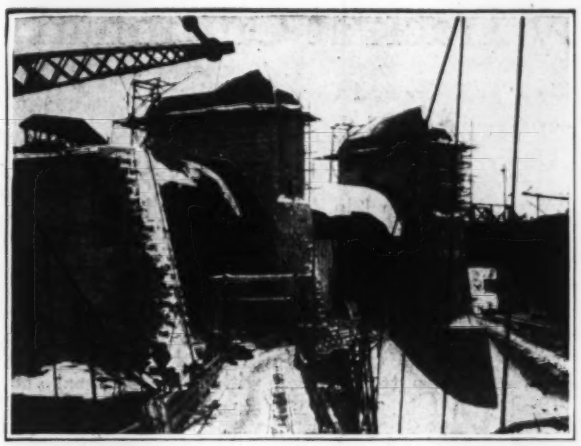


FIG. 5—ROLLER GATES AT SOLBERGFOS
Installation of roller gates was completed before remainder of dam. Gates were blocked in open position and spillway used to pass flood-flow while gravity section (at left) was poured.

The three spillway openings are regulated by roller gates and have a combined capacity of 141,000 sec.-ft. The maximum observed flood is 106,000 sec.-ft. Each roller gate has a length of 98.5 ft. and an operating height of 28.7 ft. This is the maximum height of gate yet constructed. The ends of the gates are supported on the usual toothed inclines. Operation of the gates is controlled from operating houses on the piers. Normal operation is by electric motor, but if the electric energy should fail, the gates may be raised by hand-operated hoists. It requires about 24 hours to raise a gate by hand; motor operation requires about 30 minutes. The weight of each gate is 149 tons.

A one-twenty-fifth scale model of the Solbergfos dam and power house was constructed in 1919 before active construction had started at the site. Many experiments were run and an arrangement of the spillway was determined which gave the least interference of the spillway overflow with the discharge from the power house.

Logs are not passed through the roller gates, but a separate log-run was provided opposite the power house. The run has a total length of 2,300 ft.; the upper 1,300 ft. is in tunnel around the dam and the lower part consists of timber flume. It has a capacity of 12,000 logs per hour and a large operating crew is required during the timber-floating season. The yearly cost of operating the run is about ⅛ cent per log.

Vamma—Vamma dam is about 9 miles downstream from Solbergfos. It is a concrete gravity structure with a length of 920 ft. and a maximum height of 125 ft. The power house is located at the downstream toe of the dam and contains eight horizontal reaction units. The first unit was placed in operation in 1915.

The spillway is at the south end of the dam and was excavated from rock. It has a calculated capacity of 141,000 sec.-ft. The spillway is divided into three parts; two sections are regulated by roller gates, while the third is open. The crest of the open section is at the same elevation as the top of the two roller gates. One gate has a length of 65.6 ft. and a regulating height of 8.2 ft., while the other has a length of 91.9 ft. and a height of 11.5 ft. These gates have no lip extension. The spill is trained downstream away from the power house by a heavy concrete wall.

The roller gates have a high lift and it was originally intended to pass logs under the gates. Upon demand of the logging association a separate log-run was constructed. This consists of a 7x7-ft. tunnel and a concrete chute.

Summary—The roller and sector gates described in the foregoing were constructed in the Swedish plant of A/G Maschinenfabrik Angsburg-Nurnberg. The reliability of these gates has been proved by thorough operating experience. Electric heating of the roller gates has been cheap and secure. The sector gates could be heated by electricity or by steam if it were desirable. Operating mechanism is rugged and regulation has been satisfactory. One objection to the use of the sector gates is the wide masonry base which is required. The spillway for the roller gate has the normal overflow section. Each spillway opening is spanned by a light steel bridge to afford easy passage for materials and the operating force.

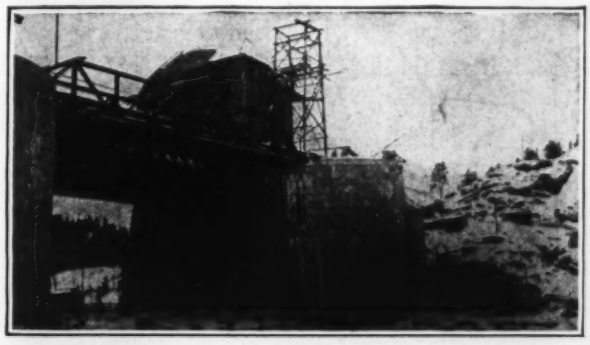


FIG. 6—UPSTREAM SIDE OF ROLLER GATE AT SOLBERGFOS
Operating bridge was used during construction by concreting cars. Spillway crest and piers are faced with granite blocks.

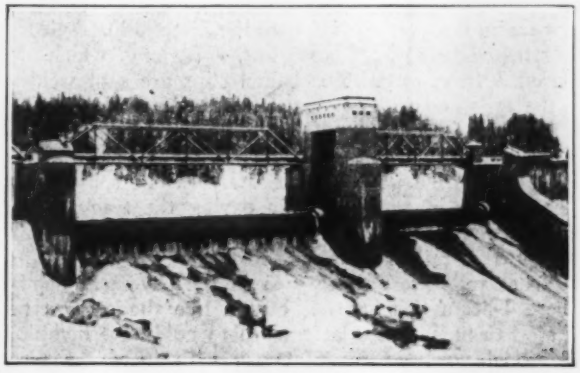


FIG. 7—ROLLER GATES IN SPILLWAY AT VAMMA
Gates must withstand heavy ice in the forebay pond. Leakage is slight and operation not affected by ice formation. Open spillway is at left of roller gates.

To Build Sewage System in Bahama Islands

The contract for the construction of a $750,000 sewage system in the Bahama Islands has been awarded to the McNamara Construction Company of Toronto, Ont. The work will consist of buildings for pump houses and sludge plant, an outfall sewer from Nassau to Key Island, and 16 miles of sewer. Work will start as soon as the necessary plant can be placed on the job. The McNamara company has just completed construction of a dock bridge and other work for the government of the Bahamas.

Rebuilding Street Railway Track at Cincinnati

Standard and Modified Track Designs With T-Girder and Grooved Rails on Steel Ties—Relations Between Company and City—Methods of Working Under Traffic

IN CARRYING out a comprehensive policy of track improvement, the Cincinnati Street Railway Company during 1927 reconstructed 26 miles of single-track line in paved streets, the individual stretches of line ranging from 500 ft. to 4 miles in length. For its 1928 work the company has started on a program for the reconstruction of an aggregate of about 24 miles of single track. The system has about 271 miles of line and is peculiar in having a gage of 5 ft. 2½ in. On old double track the space between tracks varies from 3 ft. 10 in. to 6 ft. over the gage side of rail heads, but in all new work this distance is 4 ft. 6 in.

Track Designs—For its standard track construction the company, in 1925, adopted a 7-in. T-girder rail, with 7-in. grooved girder rail for curves, as shown in Fig. 1. Variations in design are necessary in some cases on account of special conditions. The greater part of the new track, however, is laid with the 7-in. 93-lb. T-girder rails bolted to 4¼-in. I-beam ties, 7 ft. long, which are spaced 3 ft. c. to c. The bolted clips are spot welded to the rails and ties, so that there can be no slackening of the rail fastenings. This construction is shown in Fig. 2, with brick paving on Lockland Ave., and in Fig. 3, with concrete paving on Erie Ave. In some cases the concrete is used only for paving the track space, with asphalt outside of the tracks and laid directly against the rail heads. In other cases 6-in. 100-lb. T-girder rails are necessary to fit the pavement depth. These I-beam ties are not canted like the other type of steel ties mentioned later, as this would have involved additional work in manufacture, with increased cost. At all rail joints temporary bolted splice bars are applied until the joints are permanently welded by the thermit process. These welded joints are finished by grinding. No expansion joints are provided, but the few breaks that occur are usually in the solid rails rather than at the joints. They are repaired by thermit welding.

No defined flangeway grooves are provided with T-girder rails, but the paving between rails is slightly crowned so as to be 1 in. below top of rail head at each side and ½ in. below this level at the middle of the track. Between tracks the paving is crowned from ¼ in. below to ¼ in. above the level of the rail heads. In streets where the new work extends down to subgrade there is under the track (and under each track on double-track lines) a sub-drain of 4-in. farm tile, laid with loosely butted ends in a trench filled with washed gravel and covered with 1 in. of loam. These drains are laid to sewer manholes, complete plans and records being kept to show the location of drains and manhole location for convenience in future repair work.

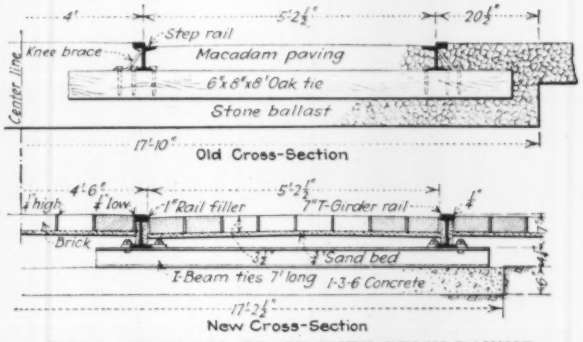


FIG. 2—STANDARD TRACK WITH BRICK PAVING

For asphalt-paved streets the city requires the use of grooved rails, and the company has adopted a 7-in. 122-lb. rail, usually secured to steel ties by bolted clips, which are spot welded to the rails and ties. At all special work, however, for turnouts and track intersections, the rails are laid with steel tie-plates on oak ties and are secured by screw spikes, on account of the shorter time required for construction. These two systems are shown in Fig. 4, Reading Road, and Fig. 5, Baymiller St. Here the steel ties, spaced 6 ft. c. to c., consist of pairs of 3 5/16-in. channels connected by two broad plates riveted across them to carry the rails. It will be noted that the ends of the ties are bent up at a slope of 1 in 25, so as to give an inward cant or inclination to the rails, an arrangement that is found to give less wear of rails than when they are vertical. These ties are embedded in concrete which is covered with a ¾-in. sand cushion for 4-in. brick paving between the rails and tracks, the city laying asphalt paving outside of the tracks. On the Baymiller St. work, however, (Fig. 5), asphalt is used also for the track paving.

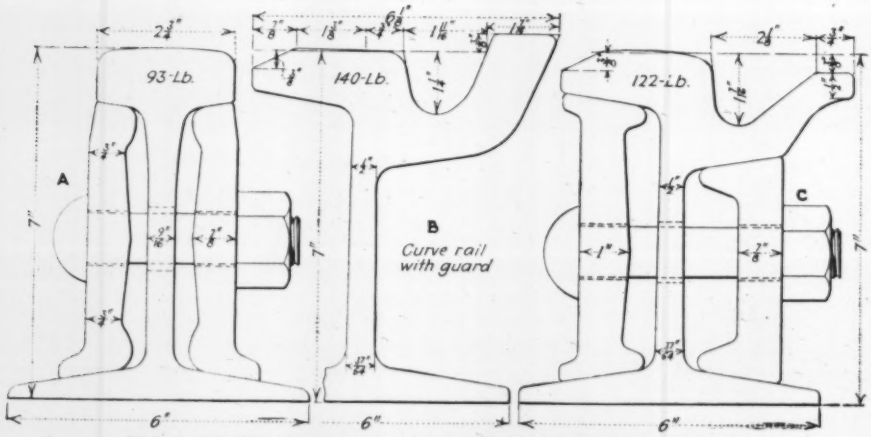


FIG. 1—STANDARD RAILS OF CINCINNATI STREET RAILWAY
A—T-girder rail, 93-lb. per yard. *B*—Curve rail with groove and guard, 140-lb. *C*—Grooved girder rail, 122-lb.

Track and Street Paving—Concrete paving for the track area consists of a 1 : 1½ : 3 mix, finished with wood

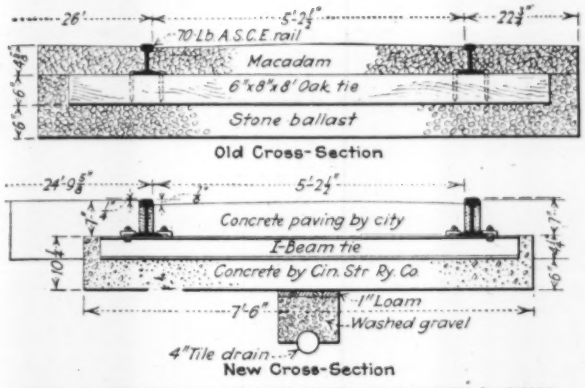


FIG. 3—STANDARD TRACK WITH CONCRETE PAVING

floats. No expansion joints are provided. Owing to the rigidity of the track, there is said to be little disintegration of asphalt laid in close contact with the outside of T-rails and both sides of grooved rails. Asphalt paving is laid under strict specifications. To prevent it from creeping, the surface of the wet concrete base is stamped with spiral depressions by means of a coiled steel bar fastened to the bottom of a block of wood.

In brick paving the work is expedited by portable roller conveyors set on an incline to deliver the bricks from the stock pile on the sidewalk to the pavers. For this paving an asphalt-sand mastic is used as filler, and this is also flushed over the entire surface. Some of the old worn granite block paving is salvaged by cutting the blocks in half and dressing them to 4½ in. depth.

All concrete up to the level of the tops of the ties is laid by the street railway company on resurfacing jobs. On new construction it is brought up to the subgrade for the paving on the sides or shoulders of the street. The city, by its own forces or by contractors, places the upper concrete for the paving base and lays the paving on the entire width of the street, except where the company builds a track independently of street work.

Construction Methods—In the construction work on double-track lines traffic is operated on one track at a time for a distance of 800 to 1,000 ft. Temporary portable crossovers with feather-edge rails are laid on the paving to connect the tracks, with plank ties embedded in a layer of excavated material as ballast. Flagmen or automatic signals then control car movements in opposite directions. These crossovers are of a special design by the company, which enables them to be used even on sharp curves. A single-track line on a steep hillside street was converted to double-track by widening the roadbed on the fill side and connecting the original passing sidings to form a continuous second track. On the single-track lines in narrow streets the work is done usually under traffic, for one or two blocks at a time, rather than interfere with car routes by detouring. During such work the street must be closed to ordinary vehicles, because concrete mixers, aggregates, cement and paving material are stored between the track and sidewalks. In such cases special efforts are made to keep this period as short as possible, usually five to ten days.

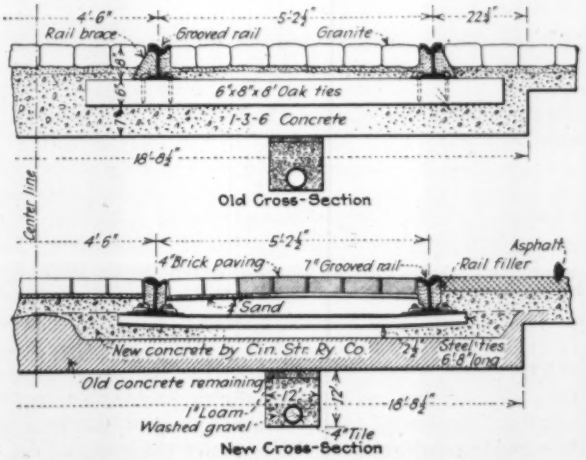


FIG. 4—TRACK WITH GROOVED GIRDER RAILS

Track concrete is ordinarily a 1:3:6 mix, and is allowed ten days to set in summer and fourteen days in winter. With a richer mix of 1:3:3, this time is reduced to four and five days respectively. But where traffic is heavy a concrete made with quick-hardening cement is used, and only three days is then allowed for setting. In some old streets, track with step rails, stone ballast and macadam paving is replaced with T-girder rails on wood ties bedded in concrete and finished with concrete paving.

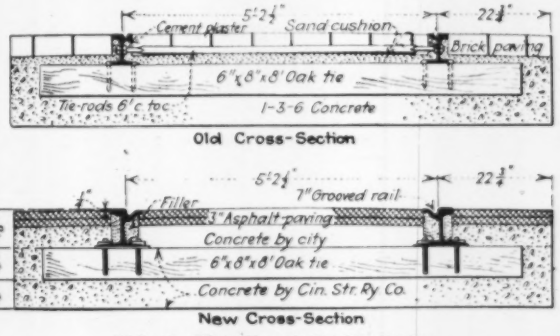


FIG. 5—TRACK ON WOOD TIES

Special methods are employed to expedite the work under traffic in busy streets. When the paving has been taken up and old concrete removed to the bottom of the ties, the new ties are laid alternating with the old ones and partly interlaced with them. Then the new rails are spiked in place and bolt spliced, being gantleted with the old rails. With a stretch of about 500 ft. of new track thus laid, the old track is shifted about 2 ft. and one line of rails is removed. The new track is then shifted into position with bars and jacks and is connected up at each end. The other line of old rails is then taken up and the old ties are removed, leaving the new track ready for final adjustment, welding, concreting and paving.

Where the street grade had to be lowered, it was necessary to break up and remove all the old concrete. But whatever possible much of this concrete was left in place, as it formed a better foundation than any new subgrade. This plan, shown in Fig. 4 (Reading Road) and Fig. 6 (Madison Road), was made practicable by using a track construction somewhat thinner than the standard design for new track. Much of the old concrete made with natural cement was found to be as hard as rock, so that for economy as little as possible of this was removed. However, where a first layer had been placed to a little above the bottom of ties and the filling concrete had been placed later, the concrete

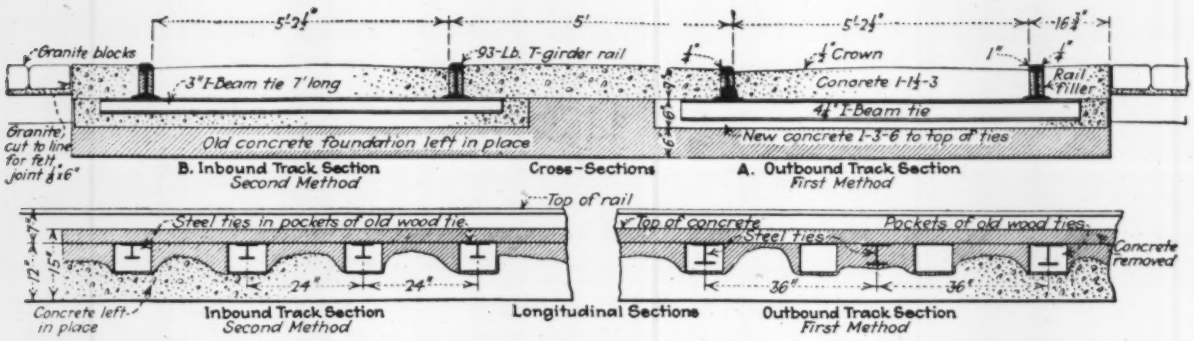


FIG. 6—METHODS OF TRACK RECONSTRUCTION

At right—Old concrete removed to make way for new steel ties. At left—Smaller steel ties placed in pockets of old wood ties at less trouble and expense.

when excavated would often separate readily along this construction plane.

In the track reconstruction on Madison Road (Fig. 6), where the lower part of the old concrete base was retained, the first track was relaid with 4½-in. I-beam ties 3 ft. c. to c., placed alternately in the old wood-tie pockets and in new pockets cut with pneumatic tools. This proved to be slow and expensive work. The other track, therefore, was laid with 3-in. I-beam ties set in all the old wood-tie pockets, which were spaced 24 in. c. to c. This latter plan avoided the cutting of any new pockets. It was hard to get out the old wood ties, as they were held firmly in the concrete. The usual method was to break up the concrete along each side of the tie with air hammers and then pry out the tie with bars. New material is delivered and old material removed mainly by the company's work trains. Concrete mixers are sometimes mounted on small cars and sometimes move along the shoulder of the street. Cement, concrete aggregate, paving materials, etc., are piled on the shoulder or sidewalk.

All the company's work is done by its own maintenance department, which has a force of about 350 men and a large equipment of construction cars, tools and appliances. J. H. Sundmaker is superintendent of maintenance of way, with W. F. Clark as assistant superintendent of maintenance.

City and Company Co-operation—As the street railway company operates under a service-at-cost franchise, all expenditures for improvement work are subject to approval by the municipal authorities. Problems relating to operation on city streets are handled by the city manager, Col. C. O. Sherrill, with the assistance of E. D. Gilman, director of public utilities, and H. F. Shipley, city highway engineer, as to engineering matters. All track improvement or reconstruction proposed by the company is planned in co-operation with the city authorities as to the streets to be selected and the types of track and paving to be used. Each year the program is made up tentatively for the following year, the city preparing a list of the streets it wishes to improve and the street railway company preparing a list of the tracks it wishes to improve. Then by joint conference these programs are adjusted and brought within the limits of financing on either side. Track work, with materials and methods of construction, are subject to the approval of the city manager, through the city highway engineer. The latter also determines the type of paving to be used in each case, and inspection of the work in progress is under his supervision. Planning the work with a view to limiting the inconvenience to the public is worked out usually in advance by conference between the company and the city authorities.

Reinforced Approach Slabs for Highway Bridges

Special Practice Developed by the Ohio Highway Department to Prevent Roughness of Road at Ends of Bridges

By W. H. Rabe

Chief Designing Engineer, Department of Highways, Columbus, Ohio

ONE of the remaining nuisances to be found too frequently on improved roads is the depression at the ends of a newly constructed bridge, due to the settlement of the backfill. The motorist, after driving along without a jar, suddenly experiences a decided bump; and, in the case of entering upon a bridge, lands on the structure with considerable impact. On gravel or other traffic-bound roads these depressions can be readily filled by maintenance forces until settlement ceases; but on rigid pavements the slab adjacent to the bridge, unless specially designed and supported, becomes broken and must be built up with bituminous material or entirely rebuilt.

This, though it may at first glance seem of little importance in an age of spectacular engineering works, is a vital subject in view of the motoring public's demand for smoother pavements and the effort which highway engineers and contractors are making to avoid rough spots.

Ohio Uses Reinforced Slabs—Reinforced-concrete approach slabs are constructed at the ends of bridges on paved roads on the Ohio state highway system to bridge the gap between the rigid end of the structure itself and the solid fill. Although the Ohio Department of Highways has followed this practice to some extent since 1922 and to a considerable extent since 1924, we began a year ago to put it in full force; and we have prepared standard plans for approach slabs to be used in this connection.

The writer is aware of the fact that many states, perhaps all, are now taking care of this problem in somewhat the same way. But the usual practice, it seems, is to provide reinforcing in the ordinary thickness of con-

crete pavement or concrete base without regard for the extent of the soft backfill to be spanned; and in the case of macadam no special provisions are made. The writer believes also, judging from inquiries received and comments made by engineers of other states, that the present Ohio practice goes somewhat more into the details of the problem and also is administered in rather more organized form, and that an explanation concerning it will be of interest.

Special Cases—Approach slabs are, of course, not used in connection with spandrel-filled arch bridges. On such bridges and the approaches thereto the usual practice is to provide temporary traffic-bound or water-bound macadam surface until full settlement has occurred, after which time the final pavement is placed.

If the approaches to a bridge involve a considerable depth of new embankment, the approach slabs are handicapped by lack of a firm support at the embankment end; but our reasoning in such cases is that if the approach embankment is considered firm enough to justify the immediate construction of the highway pavement, it is firm enough to support the approach slab. At any rate, even though the far end of this slab does settle, the end at the bridge will not; and the embankment end can later be raised if necessary. We believe it good policy, where rigid pavements are constructed on new fill approaches, to carry a construction grade slightly higher than the ultimately desired grade, so that the situation improves with age.

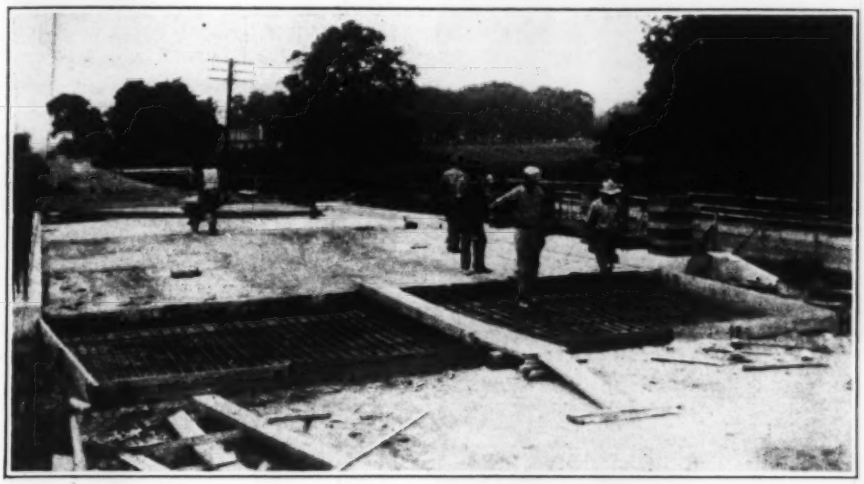


FIG. 1—TYPICAL APPROACH SLAB UNDER CONSTRUCTION
Reinforcing is in place, but concrete has not been poured. The side forms clearly define the limits of the slab. This particular approach slab will not have a separate wearing surface over it; its top will be flush with the top of a 4-in. concrete wearing surface course over the bridge which is already in place.

Where the approaches to a bridge are not paved, approach slabs are omitted; but seats therefor are provided on the abutments to take care of possible future slabs.

If existing abutments are used to support a new superstructure, approach slabs are, of course, not required. If extensions are made to existing abutments and the excavation of extensions requires backfill under the highway pavement, approach slabs are provided for the necessary width. In cases where a new abutment is placed in front of an old abutment without removing the latter, an approach slab is constructed extending from the new to the old, after the backfill between the two has been made.

The use of reinforced-concrete approach slabs is especially desirable where the abutments are of the open "buried pier" type, allowing the fill to pass through. Back of such abutments there is a greater tendency for settlement, and the use of approach slabs will eliminate concentrated live load and impact on the fill adjacent to the bridge and thus reduce the tendency for settlement.

In the design of abutments we take into account the effect of approach slabs—that is, advantage is taken of the greater vertical load on the abutment footing and the lesser horizontal earth pressure due to the elimination of liveload surcharge.

Standard Slab Plans—On the plans for an individual bridge we show a general plan view of the bridge itself with the approach slab in place at each end; and the length and thickness of the approach slab are specified. Besides, reference is made to the standard plan, on which is tabulated the thickness and reinforcing required for various lengths of slab.

On the standard plan for approach slabs we have also tabulated the number of square yards in slabs of various lengths for bridges of either 24-ft. or 30-ft. roadway width (measured above curbs, at elevation of hub). This is helpful because the slabs are constructed with flared edges to fit the transition from the width at the end of the bridge to the narrower width of the approach pavement. The flare is at the rate of 1 in 10 on each side. With minimum effort in drafting and estimating, the plan can be adapted to unusual width of pavement or bridge. The approximate quantity of reinforcing steel per square yard is also tabulated for various thicknesses, to facilitate estimating, as these slabs are paid for by the square yard, including reinforcing steel, curbs and incidental construction. Besides, the standard plan includes other information and illustrations to assist the engineer in design and the contractor in construction. The illustrations printed with this article are taken from this standard plan, which is known as Drawing Number AS-2430.

Our aim in connection with this approach slab practice is not only to provide the junction of bridge and highway embankment with a permanently smooth surface that is structurally correct but also to reduce the administrative work in connection with estimating new work or making alterations to fit conditions developing during construction. These slabs must be used with a goodly number of bridges every year, as they apply to structures ranging from a long-span steel bridge to a short-span slab, and a great many engineers are concerned with the design, construction, estimating and the like.

Slab Length—The length of slab, being a function of the excavation slope, is made eight-tenths of the height from the bottom of the abutment footing to the top of the superstructure curb. This length is measured normal to the face of the abutment. In case of a skewed abutment, the length is first determined normal to the face

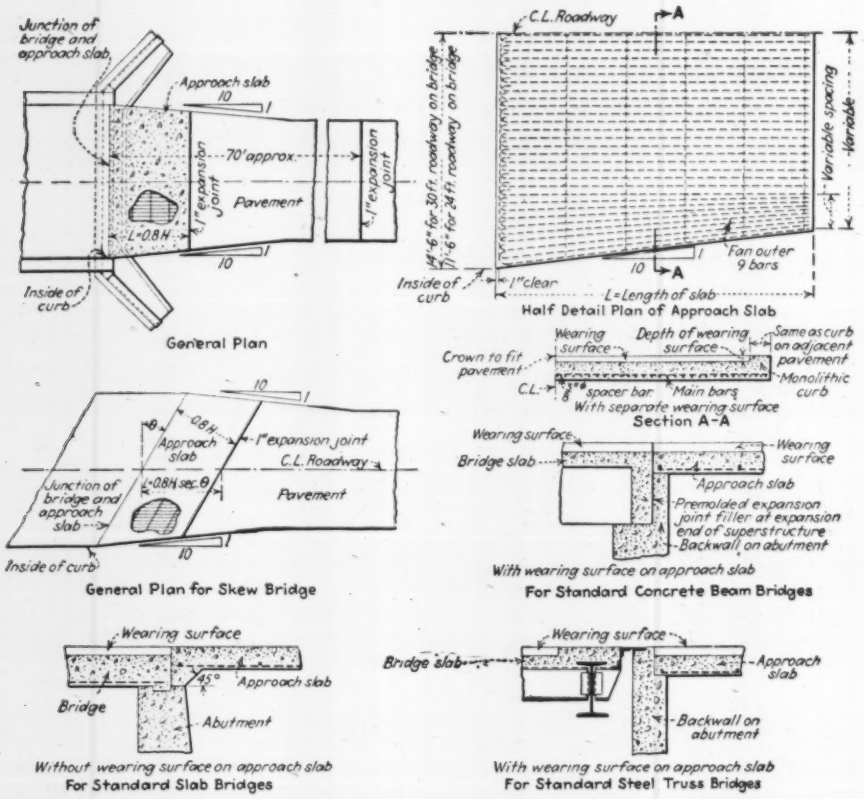


FIG. 2—DETAILS OF STANDARD APPROACH-SLAB CONSTRUCTION FOR OHIO HIGHWAY BRIDGES

of abutment and then resolved into the direction of the highway. In all cases this length is shown on the plan to the nearest foot. This determination of the length, we find, accords approximately with actual requirements. Our practice is to use no length shorter than 8 ft. or longer than 24 ft. To insure a suitable seat for the embankment end of the slab, our general construction specifications provide that where, due to the contractor's excavation operations, it is necessary to provide a greater length of approach slab than that covered by his contract, he shall provide the additional length at his own expense, together with the additional thickness required and additional reinforcing steel.

The effective span is assumed as 2 ft. less than the length of slab; this is based on the assumption that there will be about 3 ft. of solid earth under the embankment end. The end at the bridge has a concrete seat 6 in. in width, and the slab bars are hooked at this end.

Strength Design—The slabs are designed for 70 per cent of the total dead load, live load and impact moment; the reduction of 30 per cent being made because actual span length is likely to be more favorable than assumed and because these approach-slabs do not require quite as great a factor of safety as bridge slabs. The unit stresses used are 16,000 lb./in.² tension in steel and 800 lb./in.² compression in concrete. The concrete mix specified is 1 : 5, the same as for our concrete pavements. The thickness of slab is uniform for the full width. The thickness of slab for the 8-ft. length is 7 in., with $\frac{5}{8}$-in. round bars spaced 5 in.; and for the 24-ft. length the thickness is 14 in., with 1-in. round bars spaced $5\frac{3}{4}$ in. Transverse bars are $\frac{3}{8}$-in. round, with 3-ft. spacing.

Where used in connection with a concrete pavement, the surface of the approach slabs is made flush with the top of the pavement; but if the adjacent pavement has a brick or bituminous wearing surface, this surface course is carried over the approach slabs and over the bridge itself. In case of such a separate surface course, concrete flush curbs (or raised curbs, if required) are provided at the edges of the slab and cast integrally therewith.

These slabs are, of course, rather weak structurally at their edges, except when monolithic curbs are provided; but, although this apparent weakness could be corrected, the slabs would thereby lose some of their simplicity. Besides, no failures have, to our knowledge, resulted; and it is a fact that motor vehicles rarely come near the edge because of the flare in the pavement.

In construction it is obviously very important to make the earth seat of the slabs as compact as possible. It is especially important that this be done at the corners.

The approach slab practice of this department, in brief, is one that provides for different lengths of span, various types and widths of pavement, simplicity of construction and ease of administration by means of a standard plan. This practice has been developed under the supervision of J. R. Burkey, chief engineer of bridges, with the writer in immediate charge of design. Harry J. Kirk is director of highways and R. S. Beightler is chief engineer.

Italy Active in Land Reclamation

The Italian government has established an unusual system for the promotion and control of land reclamation activities in Italy, with the result that more than 3,000,000 acres of land have been completely reclaimed and work is now in progress on approximately 1,100,000 additional acres. When a given zone is officially recognized as susceptible to important agricultural changes, it is carefully surveyed and definitely bounded. The owners of the included property then form a reclamation association, managed by a board of directors, which draws up a technical and financial plan of work. After this has been approved from an engineering standpoint, the association is authorized to proceed with the work, the government contributing 60 per cent of the cost, the provinces $12\frac{1}{2}$ per cent and the land owners the rest. These quotas are collected by the same means as land taxes. When the improvement is completed, the association continues in existence as a maintenance and operating body.

Treated Timber Still Good After 45 Years of Exposure

Tests of Samples From Railroad Trestle Show Strengths Comparable to New Material—Structure Has Low Record of Replacements

By W. B. Gregory

Professor of Experimental Engineering, Tulane University, New Orleans, La.

THE Lake Pontchartrain trestle of the Southern Railway is a notable example of the use of creosoted timber. This structure was built in 1883, and has been in continuous use for 45 years in a subtropical climate with annual rainfall of more than 56 in. The structure is about 6 miles long. Originally the bents were 15 ft. apart, but the demands of modern equipment and heavier traffic have made it advisable to double the original number of supports. The structure is shown in Fig. 2. The supports are not the only parts which have been increased. Originally the crossties were supported by six stringers 30 ft. long and 6x16 in. in cross-section. These have been reinforced by adding two 8x16-in. stringers, one on either side, while the original stringers were moved a little nearer to the center line of the structure.

Timber—The timber used was all Southern pine; most of it is longleaf, but some of the material would be classed as loblolly, as the grain is exceedingly coarse. All holes

FIG. 1—CROSS-SECTIONS OF SPECIMENS FOR TEST

were bored and all framing was done before creosoting. The specifications for the structure were as follows:

The timber for creosoting shall be longleafed or Southern pine. Sap surfaces on two or more sides are preferred.

Piles—The piles shall be of longleafed or Southern pine, not less than 14 in. at the butt. They shall be free from defects impairing their strength, and shall be reasonably straight.

The piles shall be cleanly peeled, no inner skin being left on them. The oil used shall be so-called creosote oil, from London, England, and shall be of heavy quality.

The treatment will vary according to the dimensions of the timbers and the length of time they have been cut. Timbers of large and small dimensions shall not be treated in the same charge, neither shall timbers of differing stages of air seasoning, or the close-grained, be treated in the same charge with coarse or open-grained timbers.

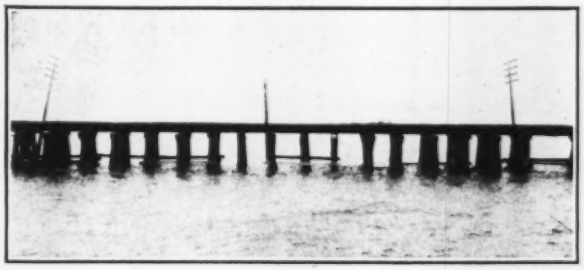


FIG. 2—A PART OF THE LAKE PONTCHARTRAIN TRESTLE OF THE SOUTHERN RAILWAY, BUILT IN 1883

The timbers shall be subjected first to live steam superheated to from 250 to 275 deg. F., and under a 30- to 40-lb. pressure. The live steam shall be admitted into the cylinders through perforated steampipes, and the temperature shall be obtained by using superheated steam in closed pipes in the cylinders.

The length of time this steaming shall last will depend on the size of the timbers and the length of time they have been cut. In piles and large timbers freshly cut, as long a time as twelve hours may be required. After the steaming is accomplished, the live steam shall be shut off and the superheated steam shall be maintained at a temperature of 160 deg. or more and a vacuum of from 20 to 25 in. shall be held for four hours or longer, if the discharge from the pumps indicates the necessity.

Oil Treatment—The temperature being maintained at 160 deg. F., the cylinders shall be promptly filled with creosote oil at a temperature as high as practicable (about 100 deg. F.). The oil shall be maintained at a pressure ranging from 100 to 120 lb., as experience and measurements must determine the length of time the oil treatment shall continue, so that the required amount of oil may be injected.

After the required amount of oil is injected, the superheated steam shall be shut off, the oil let out, the cylinders promptly opened at each end, and the timber immediately removed from the cylinder.

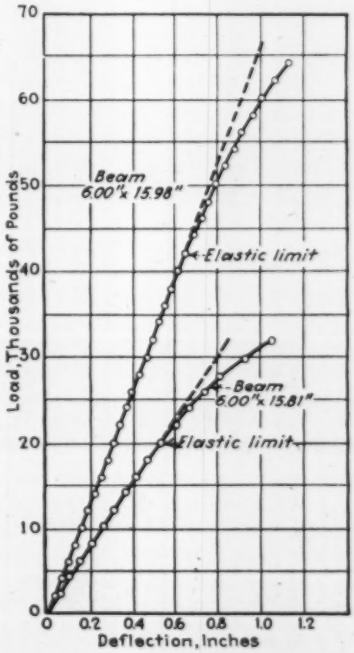


FIG. 3—MAXIMUM AND MINIMUM RESULTS OF 1928 TESTS

Specimens have given 45 years' service in Lake Pontchartrain trestle.

In the erection of timbers the sap side must be turned up, and framing or cutting of timbers shall not be permitted, if avoidable. All cut surfaces of timbers shall be saturated with hot asphaltum, thinned with creosote oil. The heads of piles when cut shall be promptly coated with the hot asphaltum and oil, even though the cutoff be temporary.

As time has passed, some changes have been made and a few timbers have been replaced. The stringers are subjected to cross-bending and are comparatively easy of examination. Of 6,908 in the original structure, 194, or about 2.8 per cent, had been replaced up to March, 1928. In order to form an accurate estimate of the condition of the structure, samples of representative stringers have been removed from time to time and tested. The first tests were made in 1909; these were followed by tests of other specimens in 1912, while the latest tests were made in 1928.

Method of Testing—All tests were made in the same way using a Riehle 100,000-lb. machine in the experimental engineering laboratory of Tulane University of Louisiana. This machine is provided with a beam for cross-bending tests, the distance between supports being 12 ft. The method of support was as follows: Each end of the beam was provided with a steel roller which rested on the beam of the testing machine, while above the roller and directly under the beam tested there was a steel plate 6x8 in. in area. The area was sufficiently great to distribute the load and prevent the shearing of the fibers of the wood. The head of the Riehle machine is 10 in. wide. A plate $\frac{3}{8}$ in. thick, 6 in. wide and 18 in. long was placed between the head of the machine and the beam tested, and the load was applied at the center of beam. The deflection was read by means of scales reading to 0.01 in. fastened to the beam at the center on both sides. Threads at the neutral axis of the beams were stretched between points above the supports and the deflection was read from the scales. The average of the two sets of the readings was used in the computations.

Individual tests of timber vary considerably among themselves, as is shown by the data, and final judgment must be largely based on averages. It will be seen from these figures that the creosoted material which has been in use for 45 years, in a warm climate with a high annual rainfall, compares favorably with new untreated wood and with recently treated wood of the same general characteristics.

TABLE I—TESTS OF TREATED PINE TIMBERS FROM LAKE PONTCHARTRAIN TRESTLE

Number of Beam	Top of Butt of Log	Width in Inches, b	Height in Inches, h	Moment of Inertia $I=\frac{bh^3}{12}$	Loads: Actual at Elastic Limit	Loads: Maximum	Stress in Outer Fiber $S=\frac{Plc}{4I}$: At Elastic Limit	Stress in Outer Fiber $S=\frac{Plc}{4I}$: Maximum	Deflection at Elastic Limit in Inches	Modulus of Elasticity $E=\frac{Pl^3}{48dI}$	Weight Lb. per Cu.Ft.	Kind
						Tests of 1909						
I	B	6.28	15.94	2,120	22,000	45,900	2,975	6,200	0.41	1,575,000	50.2	Close-grained pine, longleaf
I	T	6.00	15.69	1,934	20,000	38,000	2,915	5,540	0.465	1,383,000	47.5	
II	T	6.37	15.81	2,098	20,000	43,450	2,722	5,918	0.380	1,562,000	40.5	Coarse loblolly, large knots
II	B	6.41	16.41	2,360	16,000	25,040	1,999	3,130	0.430	979,000	42.2	
III	T	5.88	15.63	1,871	24,000	45,130	3,608	6,785	0.535	1,489,000	40.4	Close-grained, longleaf, no knots
III	B	5.88	15.90	1,965	21,000	35,190	3,054	5,120	0.515	1,288,000	44.2	
IV	T	6.00	15.43	1,835	22,000	38,425	3,320	5,810	0.465	1,601,000	40.8	Loblolly, with knots
IV	B	6.12	15.87	2,032	22,000	35,500	3,090	4,983	0.660	1,017,000	41.5	
V	B	6.00	16.00	2,048	22,000	47,000	3,090	6,610	0.400	1,670,000	47.2	Longleaf yellow pine
V	T	6.00	15.87	1,999	14,000	22,050	1,998	3,145	0.315	1,382,000	42.1	
VI	B	5.50	15.75	1,790	22,000	51,330	3,484	8,925	0.450	1,695,000	50.2	Longleaf yellow pine
VI	T	5.87	15.62	1,865	20,000	44,000	3,013	6,627	0.410	1,625,000	45.2	
VII	B	6.56	15.62	2,083	34,000	51,900	4,580	6,985	0.620	1,637,000	43.7	Longleaf yellow pine
VII	T	6.22	15.62	1,975	20,000	49,000	2,845	6,970	0.380	1,658,000	40.2	
						Tests of 1912						
I	T	6.03	15.89	2.015	26,000	38,450	3,680	5,450	0.625	1,283,000	43.3	Coarse-grained loblolly
I-A	B	6.22	16.00	2,125	24,000	29,800	3,252	4,038	0.565	1,243,000	42.6	
II	T	6.08	15.75	1,978	34,000	55,060	4,870	7,890	0.680	1,573,000	43.7	Longleaf pine
II-A	B	5.97	15.97	2,025	30,000	42,000	4,260	5,960	0.650	1,418,000	47.6	
III	T	5.86	15.50	1,818	22,000	25,700	3,380	3,945	0.615	1,224,000	39.4	Coarse-grained loblolly
III-A	B	6.03	15.55	1,889	22,600	22,600	3,260	3,350	0.645	1,124,000	39.6	
IV	T	6.46	15.61	2,086	26,000	33,740	3,530	4,575	0.825	939,000	41.9	Longleaf pine
IV-A	B	6.50	16.12	2,271	24,000	40,130	3,065	5,120	0.600	1,095,000	45.5	
V	B	6.09	15.93	2,051	38,000	54,000	5,310	7,550	0.705	1,633,000	45.1	Coarse-grained loblolly
V-A	T	6.25	15.94	2,109	22,000	41,275	2,990	5,620	0.480	1,350,000	42.5	
						Tests of 1928						
I	B	6.00	16.00	2,050	22,000	38,000	3,085	5,330	0.515	1,298,000	46.3	All material coarse-grained, longleafed yellow pine
I-A	T	6.00	15.81	1,975	20,000	34,000	2,880	4,900	0.545	1,157,000	44.5	
II	B	6.00	15.25	1,775	24,000	41,000	3,710	6,330	0.585	1,440,000	41.0	
II-A	T	6.00	15.25	1,775	26,000	38,000	4,020	5,870	0.640	1,425,000	43.1	
III	B	6.25	16.12	2,180	28,000	48,000	3,725	6,385	0.530	1,507,000	44.3	
III-A	T	6.25	16.00	2,135	26,000	38,000	3,505	5,120	0.585	1,297,000	42.8	
IV	T	6.00	15.69	1,930	20,000	38,000	2,925	5,560	0.585	1,103,000	42.6	
IV-A	B	6.00	15.62	1,910	22,000	34,000	3,238	5,000	0.545	1,317,000	45.0	
V	B	6.09	15.23	2,045	30,000	50,000	4,200	7,000	0.620	1,472,000	50.2	
V-A	T	6.00	15.81	1,975	26,000	34,000	3,745	4,900	0.620	1,322,000	47.9	
VI	B	6.00	15.98	2,040	42,000	65,500	5,920	9,230	0.645	1,986,000	46.0	
VI-A	T	6.06	15.75	1,970	44,000	56,000	6,330	8,050	0.795	1,750,000	45.1	

TABLE II—COMPARISON WITH NEW AND FRESHLY-TREATED TIMBER

Tests	No. of Beams	Actual Load: At Elastic Limit	Actual Load: Maximum	Stress in Outer Fiber at Elastic Limit	Modulus of Elasticity
Pontchartrain trestle:					
1909	14	21,357	40,851	3,049	1,469,000
1912	10	26,500	38,275	3,760	1,288,200
1928	12	27,500	42,875	3,940	1,422,500
Treated loblolly pine	108	.....	.....	2,978	1,278,000
Treated longleaf pine	44	.....	.....	4,690	1,690,000
Untreated loblolly pine	21	.....	.....	4,231	1,705,000

Lower three values obtained from Circular 115, U. S. Department of Agriculture, Forest Service, by W. Kendrick Hatt.

Testing Effect of Altitude Upon Evaporation

Tests are now being made on the top of Pike's Peak, Colo., 14,410 ft. above sea level, to determine the accuracy of a formula for determining the effect of altitude upon evaporation losses. So far tests have been made at Victor, Colo., 10,000 ft. elevation; Lake Tahoe, Calif., 6,200 ft. elevation, and in the Imperial Valley, California, 68 ft. below sea level. A copper tank 35 ft. in diameter is used. The formula was developed by Carl Rohwer, government engineer.

Sewage-Works Designed to Meet Needs of Automobile Town

Strong Domestic Sewage Plus Trade Wastes to Have Complete Treatment in Which Unique Imhoff Tank Plays Part

By Walter R. Drury

Of Hoad, Decker, Shoecraft & Drury, Consulting Engineers, Ann Arbor, Mich.

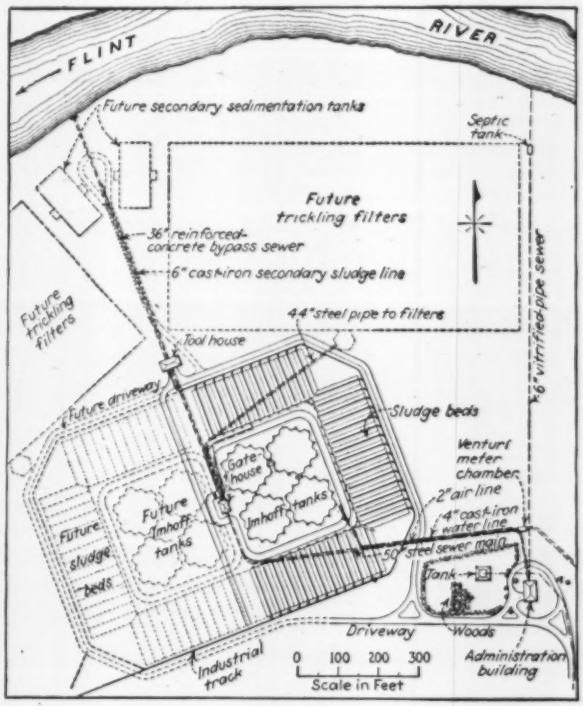
THE city of Flint, Mich., has recently completed the first units of a sewage-works consisting of large radial-flow Imhoff tanks of rather unique design, sludge-drying beds, administration and laboratory building and appurtenances. These parts of the plant were put in operation in October, 1927. Trickling filters, secondary sedimentation tanks and chlorination works are soon to be built, making a complete purification plant. This article will deal with the design of the plant. A following article by Walter S. Couse, formerly of the Flint engineering department, will take up construction.

Flint is an industrial city which in the last fifteen to twenty years has risen from the small town class into the rank of third city in the state, with a population of about 142,000. It is primarily an automobile-manufacturing city, being the home of Buick and Chevrolet automobiles and countless other allied industries, such as automobile body works, spark-plug manufacturers, spring works, varnish works and foundries. With this type of industry the most important industrial wastes are oil and grease and both alkaline and acid trade wastes, a good deal of which is disposed of by the industries themselves and is kept out of the city's sewers. At times, however, large quantities of oil and grease get into the sewers and offer a problem at the sewage-works. Aside from this waste, the sewage is mainly of domestic origin and is very strong.

The city is sewered entirely upon the separate plan, with a pretty thorough separation of surface water, so that practically no water from the streets enters the sanitary sewers. Roof water is gradually being eliminated through a rigid health department inspection so that ultimately the sanitary sewage flow will include very little if any stormwater. With a metered water supply and a small amount of groundwater infiltration, the average sewage flow is only 10½ m.g.d. from a total connected population of about 120,000. Analysis shows that the sewage ordinarily contains about 250 p.p.m. suspended solids, and the oxygen-consumed factor averages about 75 p.p.m. and the five-day B.O.D. value is about 290 p.p.m.

Sewage from the city is discharged into the Flint River, which has a drainage area above the sewage-works site of 980 square miles. The flow in the river varies from about 82 sec.-ft. average for the minimum extreme dry-weather month to about 1,400 sec.-ft. average for the maximum month. The absolute minimum recorded flow gaged in October, 1920, was 58 sec.-ft., and even smaller flows than this no doubt have occurred at times. Without sewage treatment the river was very badly polluted and during the low stages in the summer became an open sewer with unsightly sludge deposits, bad odors and an entire absence of dissolved oxygen for several miles below the city.

An order of the State Board of Health several years ago to plan for the improvement of these river conditions was whole-heartedly agreed to, and the city began to plan and construct intercepting sewers, now completed, and following these a sewage-works. A court order a year or two ago merely strengthened the order of the Board of Health. The protection of the water supplies of several cities below Flint is also involved, the principal one being that of Saginaw. Located on the Saginaw River, into which the Flint River discharges, this city obtains its water supply from the river and is now building a filtration and softening plant. It is important that the river be maintained in such degree of purity that the load on this plant will not be excessive. For these reasons and because of the desire of the city of Flint to maintain as nearly as possible the purity and beauty of the river all the way through and below the city, Imhoff tanks, sprinkling filters, secondary tanks and chlorination apparatus have been included in the program of sewage treatment.



GENERAL LAYOUT OF FLINT SEWAGE-WORKS

Imhoff tanks and sludge beds built; sprinkling filters and secondary settling tanks reserved for later but early construction.

The intercepting sewer already mentioned discharges into a sewage-pumping station, completed in 1927, which forces the sewage through a 50-in. steel pressure line, approximately 3½ miles long, to the sewage-works. The plant can be duplicated so as to have a symmetrical layout without interrupting the operation of the present plant.

Gatehouse—At the gatehouse the sewage rises in a surge well and flows over low weirs into two channels, which in turn connect with 30-in. cast-iron pipe lines, each one leading to two of the four Imhoff tank units. Each 30-in. line divides between the two tanks it serves into two 24-in. cast-iron pipe lines, each going to the center of a tank unit. With piping to each tank of identical size and length, the flow is automatically divided equally among the four tanks under any rate or condition of flow. This obviates any adjustments of valves or weirs and assures a proper distribution at all times.

Blow-off connections are provided in all low points in pipe lines so that proper cleaning of the lines of sand and solid material can be obtained if it should ever become necessary.

The settled effluent is collected in another system of piping, leading back into the gatehouse, where it is discharged into the bypass sewer directly to the river. When the filters are built, it will be discharged to the filter-dosing tank. Quarter-inch mesh screens are provided in the gatehouse to take out floating objects that might clog the filter nozzles. These screens, four in number, each with a net screen area of 19½ sq.ft., can be lifted by means of a chain falls, swung over on a washing floor, where screenings will be washed off by a hose and flushed out onto a sludge bed.

Imhoff Tanks—Each of the four radial-flow Imhoff tanks is designed for a capacity of 4 m.g.d. Each tank consists of eighteen hexagonal cells, with the outside ring of cells acting as the structural frame. The pyramidal covers over each cell, the vent stacks from each cell and the sidewalks covering the tanks are of thinner section precast units of identical shapes and sizes. Sewage is brought into the tank at the center and is drawn off through twelve orifices placed around the outside wall. Each orifice consists of a baffled 3x8-in. opening in a steel plate placed over the outlet of a pipe tee in a vertical riser pipe. These are so adjusted that each orifice will draw the same amount so that a uniform flow of sewage from the center of the tank to the outside wall will be maintained in all directions. The top of the outlet pipe is left open as an emergency overflow. A scum baffle is placed around each orifice to prevent oil and grease and other floating material from going with the effluent to the filters.

Near each outlet orifice a skimming gate, set in the tank wall, skims off floating oil and grease and discharges them through the sludge piping onto one of the sludge beds. These gates consist of a specially designed 12x12-in. downward opening sluice gate, so that the top of the gate comes to the level of the sewage and acts as a skimming weir. There are twelve of these in each tank.

The sedimentation compartment of each tank is designed for a 4-m.g.d. rate, figuring a three-hour detention period with 4 m.g. assumed to come in eighteen hours, making a nominal four-hour detention period based on the average flow for 24 hours.

The sludge compartment of each tank is divided into eighteen hexagonal pockets, six in the first row or ring around the inlet and twelve in the second row around the outside of the tank. The inner row of pockets, which will receive the heavier, more quickly settling sludge, may be emptied by an air lift and discharge it into one of the outer rows of sludge pockets. Further settlement of finer material and further digestion will take place in the outer pockets. When the sludge is ready for drawing off, this will be done by means of gravity flow from the outer pockets to the sludge beds. The total sludge volume is based on a unit volume of 2.75 cu.ft. per capita. Each tank is designed for a population of 40,000.

The gas vents, eighteen in number in each tank, hexagonal in shape, are built together with the sludge slopes of precast concrete slabs. The gas vents are 10½ per cent of the total area of the tank. They are carried up to a point 5 ft. above the normal sewage level and 2 ft. above the side walls.

In operation sewage enters the tank at the center, divides and flows radially in every direction with a decreasing velocity toward the outside wall. Advantages of the radial-flow cellular tank over the ordinary rectangular type of tank are: (1) The unusually slow rate of sewage flow through the sedimentation compartment near the outlets aids in the removal of the finer suspended particles that are never allowed to settle in a tank giving a constant velocity through the sedimentation compartment. (2) The gradual reduction of velocity tends to stop eddy currents and aid in the sedimentation of the finer particles. (3) The position of the numerous gas vents and walkway system breaks the force of the wind action on the surface, eliminating a frequent and serious cause of short circuiting. (4) The mechanical moving of the heavier sludge from the inner to the outer sludge cells improves and shortens the digestion process. (5) No periodic reversal of flow is necessary. (6) The hexagonal shape of sludge cell and hopper are better than the square shape from the standpoint of efficiency and effective removal of sludge. (7) The hexagonal gas vents and sludge sheds can be readily formed of precast concrete slabs, with smooth troweled surfaces, set and joined without expansion joints. (8) This tank lends itself readily to the accurate and equitable division of the total sewage flow between parallel units and avoids the inequalities in distribution of sewage and sludge which occurs in rectangular tanks.

The structural design of the tank is such that the outside walls are practically vertical, with no buttresses or counterforts. The outside row of sludge pockets consists of twelve hexagonal cellular units, heavily reinforced, which act as a retaining wall up to the elevation of the slot. Above this point the outside wall is cantilevered onto the lower portion. The soil conditions were exceptionally good, being a very hard blue clay at the bottom and lower portion of the tank and sand and clay mixture above. In the design of the tanks some credit is given to the backfill around the tank, which comes up to the normal sewage level as a support for the tank walls, but the design is such that, with a generous factor of safety, the tanks would safely stand full of water even with the backfill taken away. The main walls and heavier portions of the tank are built of concrete designed as 2,000-lb. concrete, but on actual test during construction it showed a strength of nearer 2,500 lb., while the precast slabs in the gas vents, sludge slopes and walk are designed for 3,000-lb. concrete, heavily reinforced, which on test showed a somewhat greater strength.

Sludge-Drying Beds—The sludge beds, 24x125 ft. in plan, 40 in number, are built with tile underdrains covered with gravel and sand, with division walls of cypress planks held by means of precast slotted concrete posts. The total area of sludge beds is based on a unit of 0.75 sq.ft. per capita of tributary population, the entire plant being figured for 160,000 people. A 24-in. gage industrial track is laid in each bed and connects with a track around the plant and leads to a ravine near by, where sludge will be dumped.

Administration Building—An administration building, fully equipped with laboratory, office, toilet rooms and garage for the use of the plant operators, has been built. In this building the Venturi meter register is also housed, connected to the Venturi meter in the steel force main. An air compressor and other small equipment are housed in the basement of the building. Water from a deep well is pumped to a 50,000-gal. elevated tank for works-supply purposes.

Garage Has Mechanical Handling for Cars

Automobiles in 22-Story Chicago Garage Are Moved From Entrance to Storage Space and Returned to Exit Without Using Their Own Power

A 22-STORY GARAGE in the downtown business district of Chicago which has storage capacity for 572 cars and in which the cars are moved vertically by elevators and horizontally by transfer tables, without the use of their own power, is a new development toward solving the parking problem in congested districts. It is also a step toward providing parking accommodation for tenants in office buildings, since this garage occupies the center of one of Chicago's largest skyscraper structures. —EDITOR.

A COMBINED multi-story garage and office building in Chicago which in design and equipment is the first of its kind has enabled extensive garage facilities to be established in the business district, where land values are too high to permit of large modern buildings for commercial garage purposes alone, except for greater heights than are considered practicable with ordinary methods of handling cars. This combination is a distinctive feature of the Pure Oil Building, at Wacker Drive and Wabash Ave., which has its office entrance on the upper level of Wacker Drive, while the garage entrance at the rear, in Holden Place, is at the lower street level.

The 41-story Pure Oil Building (originally the Jewelers Building), illustrated in *Engineering News-Record* of Jan. 13, 1927, p. 66, is 162x140 ft. in plan for the first 22 stories. In this part of the building there are offices on the four sides, inclosing an interior space 66x88 ft., which is utilized for the garage and is entirely isolated from the office space. As all the offices have outside windows, there is no necessity for the interior or central light court ordinarily required on large office buildings.

Each of the 22 garage floors above the entrance floor can accommodate 26 cars, 22 of which can be removed promptly, while four are in "dead" storage or left for some indefinite period. Thus the total storage capacity is 572 cars. Four electric elevators spaced 18 ft. 3 in. c. to c. of shafts handle the cars, and each floor has two electrically operated transfer tables, on opposite sides of the row of elevators, so that each elevator can serve six cars or storage spaces. In structural design and mechanical equipment all the floors are identical. As the automobiles are not operated under their own power in the building, there is no necessity for special ventilation above the first floor, while the method of handling avoids the usual requirement for driveway space on the floors. Furthermore, with each floor isolated from the shafts by fire doors, a low insurance rate has been obtained. On the first or main floor are the entrance and exit driveways, offices and car-washing space. The only persons using the upper floors are the garage attendants. The transfer tables, which are the special feature in this new type of garage, are steel skeleton frames 72x20 ft., mounted on wheels traveling on tracks of ordinary railway rails, parallel with the rows of elevator shafts. They are operated by motor-driven cables. On each table are twelve tracks or pairs of channels to receive the automobiles, spaced 6 ft. 1 in. c. to c. Thus with a travel of a little more than 12 ft. each table can

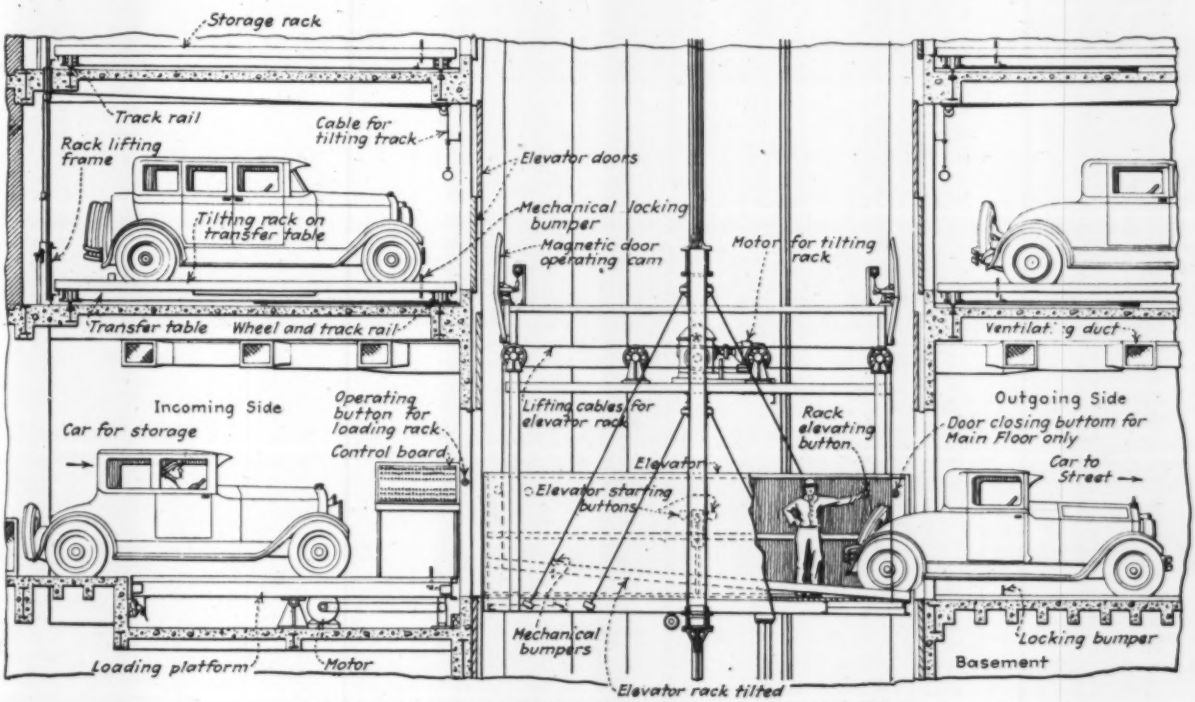


FIG. 1—GARAGE WITH ELEVATORS AND TRANSFER TABLES

bring any one of three automobiles opposite each elevator; and with the two tables each elevator serves six cars. The two tables provide accommodation for 24 cars, any one of which can be promptly shifted to an elevator for removal. Four fixed tracks between the elevators provide for four cars which are stored for some indefinite time, as in the case of owners leaving town.

Typical layouts are shown in Figs. 1 and 2. The operation, which is really more simple than the description, may be explained as follows. A car entering the garage is driven onto a loading platform in front of an elevator, the owner then leaving it, with brakes released and doors locked. He is given the usual receipt or check. At each elevator shaft is an annunciator or master-control board, which indicates each occupied and unoccupied

By push-button control the elevator operator runs the car to the floor selected, the door of the shaft opening as the elevator completes its movement. By pulling a cord the operator causes the track on the elevator floor to tilt up and thus run the car out onto the transfer table waiting to receive it. There it is locked in position and remains until it is to be taken out of the garage, although the table is shifted from time to time to receive or deliver other cars.

Opening or closing of the doors at the elevator shafts is effected automatically, in such a way that the door is fully open when the elevator reaches the floor level. This eliminates much delay—in fact, the operations are so timed that a car can be moved from the loading platform into the elevator in five seconds, and from the elevator to the storage space in about six seconds. The

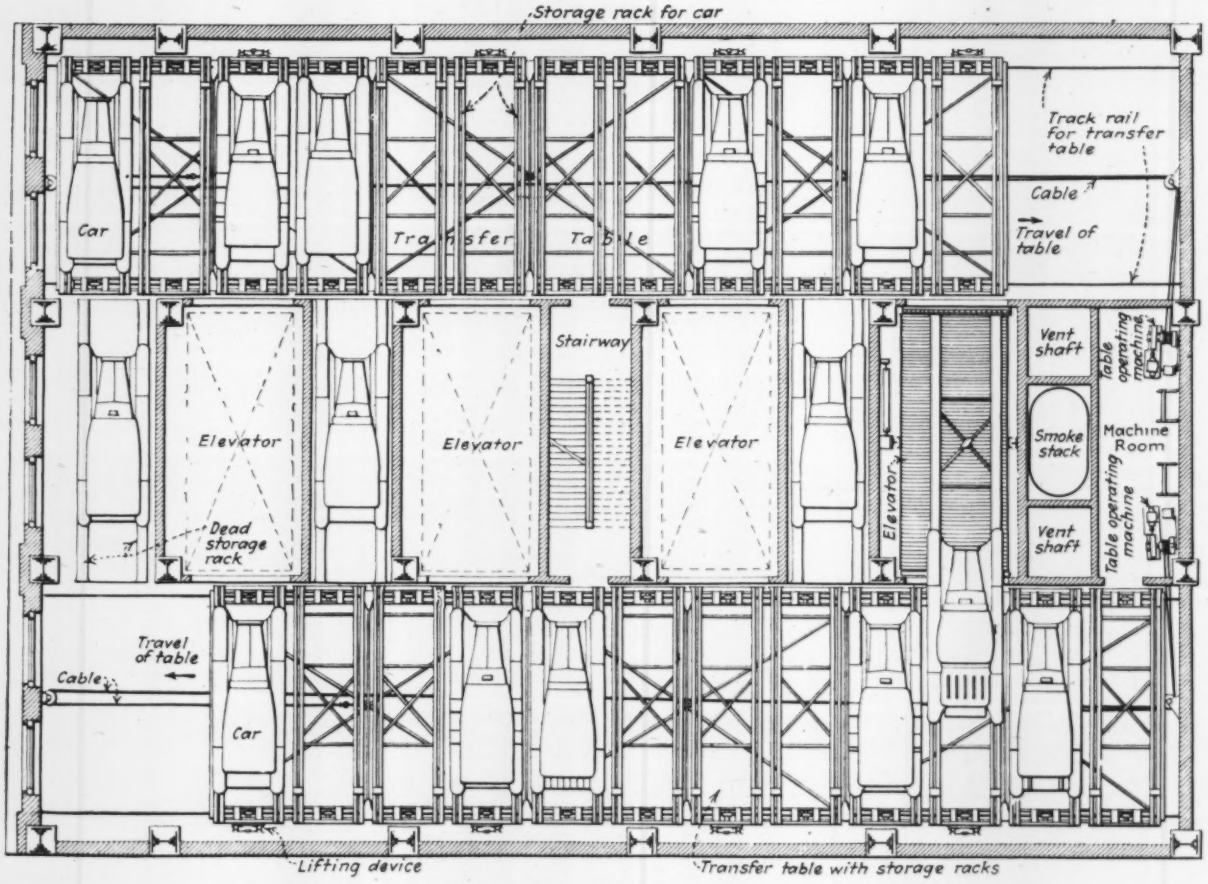


FIG. 2—TRANSFER TABLES STORE AND MOVE AUTOMOBILES

space on each floor. When the garage attendant has selected the storage space for the car, he removes a key from the corresponding place on the board and delivers this key to the car owner.

Removal of this key automatically causes the appropriate transfer table to bring the selected storage track opposite the elevator. The elevator door at the main floor is then opened and the approach or loading platform is tilted automatically by power so that the car runs by gravity into the elevator, where it stands on channel-shaped wheel guides. Its movement is stopped by bumpers in these guides, while recoil is prevented by locks rising behind the rear wheels. This completes the work of the attendant on the main floor.

elevators have a vertical speed of about 500 ft. per minute.

When the owner calls for his car, he hands the annunciator key to the attendant, who replaces it in the board, thus causing the transfer table to shift the car in position at the elevator. As the elevator door opens, the elevator operator pulls a cord and causes the track on the table to tilt and run the car into the elevator, the door closing as the elevator starts to descend. In Fig. 3 an automobile is shown entering the elevator in this way. As the elevator reaches the main floor, the door opens and the deck is tilted to roll the car out at the opposite end from the loading platform where it was run in. The owner can then enter his car and drive

FIG. 3—REMOVING AUTOMOBILE FROM STORAGE FLOOR
Elevator operator is pulling cord, causing track to tilt and run car into elevator. Tracks or channel guides for wheels rest on steel-frame transfer table, one wheel of which is shown at left of elevator door.

away. A car can be sent from its storage space on the top floor down to the exit driveway on the main floor in two minutes, and four cars can be handled simultaneously. The sequence of operations is controlled by mechanically and electrically interlocked devices.

Among the principal claims for this garage system are: (1) The financial possibility of locating garage parking space and facilities in business districts and in buildings of any height permitted by city ordinances; (2) the elimination of driveway space on the floors; (3) the rapid movement of cars in and out of elevators due to the tilting tracks and door-control apparatus; (4) the quick delivery of stored cars when called for; (5) the elimination of the necessity of operating automobiles under their own power within the building; (6) the provision of parking space for tenants of offices in the building; (7) the large storage capacity of a given floor area, since no driveway space is required; (8) the fact that the cars are locked and are not entered by garage attendants in order to move them; (9) the avoidance of all chance of damaging a car by collision with another car or with a building column. There is, of course, reliance upon electric current and intricate apparatus, but the hazard of interruption in this respect is small.

The mechanical features of this garage system have been developed and patented by C. W. Ruth, and the installation in the Pure Oil Building was made by the C. W. Ruth Engineering Company, Chicago. This building was designed by F. P. Dinkelberg, architect, Chicago, assisted by the late J. G. Glaver as structural engineer. It was planned originally for its present combined use as an office building and a garage having the Ruth system of operation.

Long Concrete Bridge Opened in England

The Royal Tweed bridge at Berwick, England, was officially opened by the Prince of Wales on May 16. The structure, according to *The Engineer*, London, is the longest concrete bridge in that country, having a total length of 1,405 ft. There are four main arch spans of 361.5 ft., 285 ft., 248 ft. and 167 ft., respectively, and two approach spans. The total width of 46 ft. is made up of a roadway and two sidewalks. The bridge will support a moving load of 1,350 tons and will cost approximately $778,000, including real estate. A notable feature of the design are the arch ribs, four to each main span, which are hollow except for the middle third.

Water-Supply Struggles of a Small Southern City

Mount Airy, N. C., Has Ample Supply of Filtered Water After Changes and Enlargements of Source During Quarter Century

By Major Preson P. Phillips
Designing Engineer, Gilbert C. White Company, Durham, N. C.

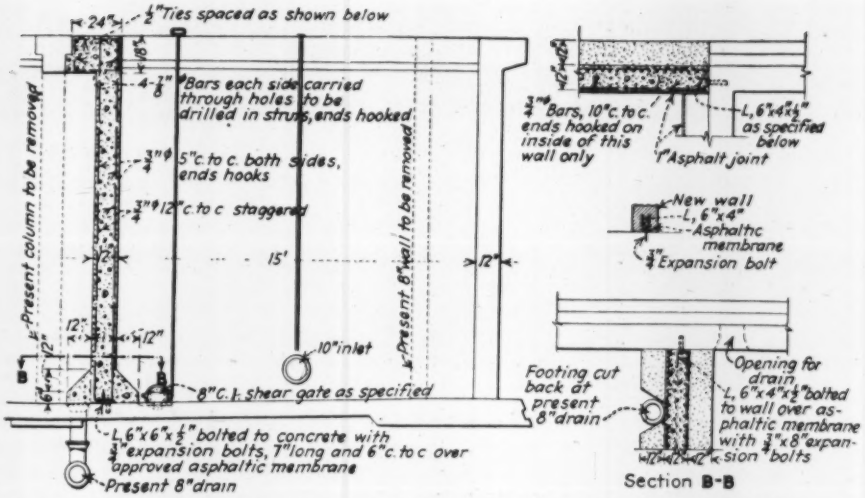
RAPID growth of Mount Airy, N. C., and inadequate forecasts of water-supply needs have been the cause of frequent changes in the water supply of the city in the quarter-century since the first supply was introduced. In 1927 new supply works, incorporating small portions of the old, were built that promised to be ample for the immediate future and to be readily enlarged to meet the needs of the city for more years than it now seems reasonable to anticipate. These works, which draw on a new source of supply, divert water from the natural flow of Lovill's Creek through a gravity supply main to a water treatment and pumping plant designed to supply 1.5 m.g.d., which would give 200 gal. per capita daily to the present estimated population of 7,500. Mount Airy is located about 4 miles from the Virginia line, almost at the foot of the Blue Ridge Mountains. The largest open-face granite quarry in the world is largely responsible for the growth during the past few years.

Historical—The public water supply of the city dates from 1903, when the Rucker-Witt Tobacco Company drilled a deep well near the center of the present city and began selling water. This supply immediately proving inadequate, the "town well" was dug by the city just outside of the city in 1904, and the city started operating its own water-works. The well was 25 ft. deep and 40 ft. in diameter, built around a spring and lined with brick. Water was pumped to a wooden tank (capacity unknown) erected on a hill in the northern edge of town. This well also proving inadequate, in 1905 a small intake dam was built across Creasy's Branch (watershed area, ¼ square mile) and a 4-in. spiral steel pipe laid to the "town well," from which it was pumped, without treatment, to the existing wooden tank. In 1910 an intake dam, about 3 ft. high, was built across Tumbling Rock Branch (watershed about 1 square mile) and an 8-in. spiral steel pipe line 4,600 ft. long was laid to the

LABORATORY OF MOUNT AIRY WATER-FILTRATION PLANT
Filtered water-sampling table at left of desk. Tops of two of the three dry-chemical-feed hoppers may be seen through window at right.

old brick well. Pumping to the old wooden tank was continued.

In 1913 the first filter plant was built: A small brick coagulating basin, a chemical control house, two 0.25-m.g.d. filter tubs, only one of which was equipped, and a 0.15-m.g. reinforced-concrete clear-water reservoir. This same year the wooden tank on the hill was replaced by a 0.15-m.g. elevated steel tank. The filtered water was now treated with sodium hypochlorite. In 1915 new pumping equipment was added, and in 1922 the second filter tub was equipped and liquid chlorine substituted for sodium hypochlorite. In 1924 a concrete coagulating basin, designed to treat 1 m.g.d. of water, was built, and the 8-in. spiral steel pipe, being badly rusted and leaky after some fourteen years of use, was replaced by a 10-in. cast-iron pipe.


24"
½" Ties spaced as shown below
4-⅞" Bars each side carried through holes to be drilled in struts, ends hooked
¾" ϕ 5" c. to c. both sides, ends hooks
¾" ϕ 12" c. to c. staggered
15'
12"
Present column to be removed
Present 8" wall to be removed
10" inlet
8" C. I. shear gate as specified
L, 6"x6"x½" bolted to concrete with ¾" expansion bolts, 7" long and 6" c. to c. over approved asphaltic membrane
Present 8" drain
¾" Bars, 10" c. to c. ends hooked on inside of this wall only
L, 6"x4"x½" as specified below
1" Asphalt joint
New wall
L, 6"x4"
Asphaltic membrane
¾" Expansion bolt
Footing cut back at present 8" drain
Opening for drain
L, 6"x4"x½" bolted to wall over asphaltic membrane with ¾"x8" expansion bolts
Section B-B

COMBINED ROOF OVER SUCTION WELL AND FLOOR TO PUMP ROOM
Because the roof is under pressure, the superimposed floor has a drainage system to keep water from pump room.

In 1925, the supply of water again proving inadequate, a 21-ft. earth dam, designed to impound 10 m.g.d., was built just above the old intake on Tumbling Rock Branch, and a 0.2-m.g. elevated steel tank erected.

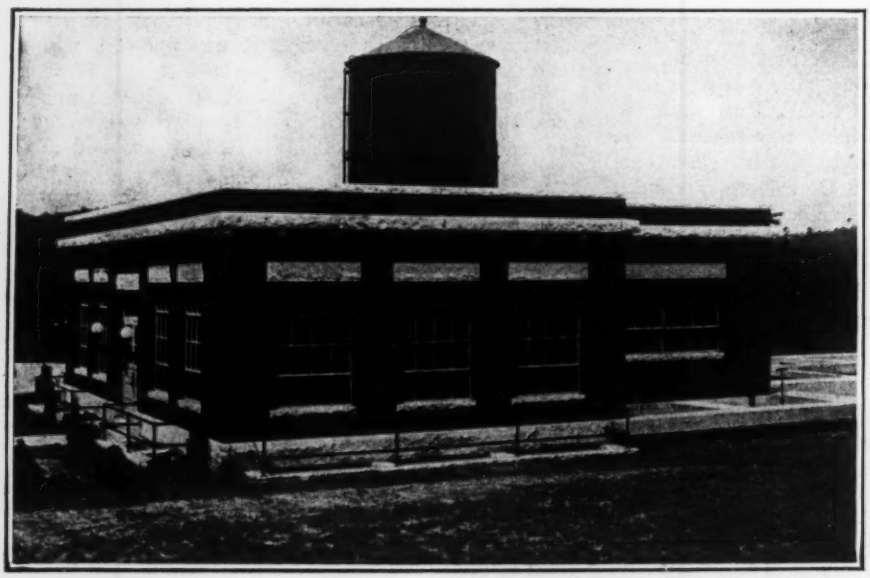
In 1926, it having been necessary to pump raw water from a near-by creek for a time during a dry spell, the city engaged the Gilbert C. White Company to make a report on its water supply. It was found that the watershed area of Tumbling Rock Branch had been developed to beyond its capacity; that the treatment plant was badly scattered, some parts of it being obsolete, and the others inefficient; and that the only structures worth incorporating in the proposed new plant were the new coagulating basin and the clear-water reservoir.

The best source of supply, sufficient probably forever, was found to be Lovill's Creek, at Green Hill mill dam, about 3 miles from the city. The watershed area above this point is about 22½ square miles and the estimated flow of the creek, without storage, some 3 m.g.d. With storage 4.5 m.g.d. could be had. A small concrete intake was built at this point, above an existing mill dam, and from it a 14-in. cast-iron gravity supply was laid about 3 miles to the new filtration plant, at the site of the old brick well, built in 1904. Construction on the new supply works was started on Jan. 1, 1927, and was completed in the following August.

Mixing Chamber—The mixing chamber is rectangular, with over-and-under baffles. It has a retention period of about fifteen minutes when operating at the rate of 1.5 m.g.d.

Coagulating Basins—The old coagulating basin and mixing chamber were combined, divided to give two coagulating basins each about 16x72 ft., and a new 12x72-ft. basin added, giving a total retention period of five hours, when operating at the rate of 1.5 m.g.d. Any one of the three basins may be drained for cleaning and any one of the three filters may be operated with any one of the coagulating basins.

A novel method of connecting the new walls to the old floor and walls was used. At the point to be the center of the new wall a 6x4 angle was bolted to the floor for the full length of the basin, and up the side walls. For watertightness, an asphaltic membrane ½ in. thick and 4 in. wide was placed under this angle to take care of all unevenness in the surface of the concrete, and gave a tight joint between the angle and the concrete. This angle, securely bolted to the floor, also



WATER FILTRATION AND PUMPING PLANTS, MOUNT AIRY, N. C.
Brick building trimmed with local granite houses chemical room, raw-water controller and laboratory above, pumps and filter-pipe gallery below, with suction-well on third level. Part of coagulating reservoirs and mixing chamber shown at right; wash-water tank in rear; covered clear-water reservoir at left of building.

served to anchor the bottom of the wall, otherwise holes would have had to be drilled to take the reinforcing steel in this wall, or a groove 6 in. deep and 12 in. wide cut in the floor to give a bearing. The new 12-in. wall was centered on this angle. There has been no leakage at these joints.

Filters—Three 0.5-m.g. rapid sand filters, with necessary piping and operating tables, are under the same roof as the pump room.

Pump House—Pumps, laboratory, dry-feed machines, chemical storage and filters are all housed in the same two-story building. The filters are all on one side of the pipe gallery, this being a part of the pump room and making the piping very accessible. Under the pipe

Floors to have slight slope to here.
Split building tile or heavy furring tile laid as shown.
8"
3/4" ϕ Bars, 12" c. to c. both ways, top and bottom
18"
6" Drain tile surrounded by gravel drain to manhole

JOINT FOR WATERTIGHTNESS IN WALLS OF COAGULATING BASINS

gallery for the full width of the pump room is the suction well and filtered-water conduit.

The top of the suction well being below the elevation of the water in the clear-water reservoir, precautions were taken against upward leakage into the pump room. The top of the well, reinforced for upward pressure, was built 6 in. below the finished floor. Over this was laid heavy split wall or furring tile, leading to the edge of the well and connecting with a line of drain tile, surrounded by stone, ending in a manhole outside of the building. No leakage has developed to date. The floor of the pipe gallery was laid on top of this tile at the same elevation of the pump-room floor.

The pumps, which are expected to run only twelve to fourteen hours a day, are three in number: An old motor-driven pump, having a capacity of 675 g.p.m.; an old gasoline engine-driven pump with a capacity of 1,500 g.p.m. for emergency fire use; and a new motor-driven pump with a capacity of 700 g.p.m. In the pump room is also located a 12-in. Venturi tube for measuring the raw water connected to a recording stand on the operating floor; and a 12-in. float valve for controlling the raw water as it enters the mixing chamber.

Operating Floor—In the second floor of the building are a laboratory, a chemical storage room, three dry-feed machines for alum and soda ash or lime, chlorine room and a raw-water indicator. The laboratory is separated from the rest of the floor by a hollow-tile and glass partition. The chlorine is fed into the filtered water as it passes into the effluent conduit over the suction well.

Clear-Water Storage—A new 0.5-m.g.d. circular, covered, clear-water reservoir was built. Piping from the clear-water conduit is so arranged that a portion of all filtered water must go to the reservoir and return to the suction well; thus the water in the reservoir is kept in constant circulation. The old clear-water reservoir will be continued in service and will be covered at a later date.

Wash-Water Tank—In the old plant the filters were washed directly from a wash-water pump. The new plant includes a 0.05-m.g. elevated steel wash-water tank.

General—The total cost of the plant was about $140,000. The general contractor was Tucker & Laxton, Inc., Charlotte, N. C. The Gilbert C. White Company, Durham, N. C., did all the engineering work.

Letters to the Editor

The King County Pavement Tests

Sir—Permit me to comment upon Mr. Hirst's letter in *Engineering News-Record*, Aug. 9, 1928, p. 202, in the matter of the King County pavement-slab tests. By the statement that "it was understood in advance that the demonstration was experimental in nature and that the specifications were tentative in character," Mr. Hirst doubtless means to imply that he so understood. I was not advised of any such understanding in advance of these facts.

How representative of the entire pavement were the random panels from which the test slabs were cut is of course open to question. I may state that there was a pronounced difference in appearance in the exposed sides of the two kinds of pavements when the ribbons were removed. The random slab of "compressed concrete" selected did not differ from the others of its kind as viewed from the side.

It is true that the average modulus of rupture of the compressed concrete closely approached that of the other concrete. It is also true that the *minimum* modulus of rupture fell below the minimum of the standard 1 : 2 : 3 concrete by 18 per cent with the tension on the top, and by 17 per cent with the tension on the bottom.

Mr. Hirst's statement that the standard pavement contained 34 per cent more cement than the vibrated is probably a typographical error: 1.67 bbl. — 1.30 bbl. = 0.37 bbl.; 0.37 ÷ 1.30 = 28.5 per cent.

If the modulus of rupture is multiplied by the section modulus and that product is divided by the length of some lever arm, then the load that a slab can carry may be computed. It is the load that a pavement can carry that is of importance. I would rather have a 6-in. pavement with a fair and uniform modulus of rupture than a 4-in. pavement with a somewhat higher average modulus of rupture.

The control of the construction may have been uncertain, as Mr. Hirst stated. The demonstration section was not put in under the control or supervision of the King County engineer's office, but under the supervision of representatives of the patentee.

Referring to the Bureau of Public Roads tests, I think it is only fair to state that I do not believe that the 85th St. pavement was put in in accordance with the bureau's methods of slab construction. The bureau used a concrete too dry for hand finishing, vibrated each square yard of pavement approximately two minutes and had the slabs confined laterally by the forms. As stated in my article, the 85th St. pavement was commercial work. THOMAS R. BEEMAN.

Seattle, Wash.,
Aug. 22, 1928.

Dump-Trucks for Ready-Mixed Concrete

Sir—The interesting description of the new plant of the Ready Mixed Concrete Company at Pittsburgh, by E. N. Jones, in *Engineering-News Record*, Aug. 9, 1928, p. 196, including details of the 3-yd. end-dump truck, reminds me of the truck used by the Ready Mixed Concrete Corporation of New York. When in that city recently I followed into a new building on 40th St. near Fifth Ave. a motor truck on which was mounted a slowly revolving steel cylinder. A man in charge courteously informed me that the concrete is made at a plant at 70th St. and the East River. A separate small engine on the truck rotates the 3-yd. cylinder or body very slowly during the run from mixing plant to where used. The cylinder, which is of riveted ⅜-in. plate, is of the end-dump type with a small door at the back end, hand operated by rack and pinion. The concrete which flows out is of good, even consistency. A dump body of this type would prevent any settling of the aggregate and any accumulation of water on top, as in a hopper-shaped body; and probably the slight additional mixing en route does no harm. It seems to me that the design of dump-trucks for concrete would be a good topic for discussion.

M. W. VON BERNEWITZ.

Pittsburgh, Pa.,
Aug. 20, 1928.

News of the Week

Sewage Conference Held in Texas

Representatives from about 50 Texas towns gathered at Cleburne, Tex., Aug. 27 to inspect the new vacuum degasification system recently installed there. This was described in *Engineering News-Record*, Aug. 30, 1928, p. 319. Recent simplifications have resulted in slight changes to the original design as there described. The overhead tanks and floats have been eliminated, and an inverted steel drum substituted in the dosing chamber. This is equipped with two-way check valves and operates with the rise and fall of liquid in the dosing tank to create an alternate compression and suction.

It was the sense of the meeting that further study to determine the exact physical and biochemical reactions occurring in the sedimentation and digestion processes in the Imhoff tanks should be undertaken, the results to be used to indicate the general design, shape and size of new tanks more workable for this process. The newly established experiment station at Texas Agricultural & Mechanical College, College Station, Tex., is planning to work along this line. F. E. Giesecke, in charge of the station, is co-operating with J. C. Anderson, state health officer, and V. M. Ehlers, state sanitary engineer.

Well Starts Typhoid Outbreak

Drinking water from a well near the plant of the Ohio Steel Foundry at Springfield, Ohio, started an outbreak of typhoid among the 1,500 employees of the foundry. According to *Ohio Health News*, the official organ of the Ohio State Department of Health, 33 cases of the disease were reported, resulting in three deaths. The use of the well was stopped about ten days after the first case of typhoid was reported.

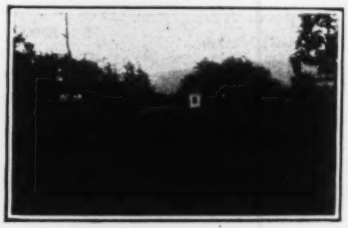
ANOTHER NORTH CAROLINA FLOOD PICTURE

This picture supplements those given in last week's issue, p. 330, showing the flood damage suffered by highways in North Carolina. The slab of this side-hill concrete road was broken in two by the force of the waters of the adjacent stream.

Heavy Rainfall on Small N. Y. Stream Causes Record Flood

Roads and Bridges Suffer Damage in Rondout Valley—Heavy Rainfall Recorded

A NARROW valley twelve miles long and less than one mile wide near the headwaters of Roundout Creek, New York, in the foothills of the Catskill Mountains, was the scene of an extremely destructive flood on Aug. 26. The damage was limited almost entirely to the short section between Grahamsville and Napanoch, N. Y., although the creek for the twenty miles downstream to its outlet in the Hudson River at Kingston, N. Y., reached unprecedentedly high levels, flooding cellars and roads. Apparently, however, the destructive velocity which did so much harm in the upper section had decreased to such an extent in the wider valley below that water damage only was suffered.



Filling in washout around end of concrete bridge at Wawarsing, N. Y.

A number of rain gages are maintained in the affected area by the New York City Department of Water Supply, which is contemplating the construction of a reservoir and dam in the Rondout Valley. One of these, at Grahamsville, N. Y., showed a precipitation of 6.81 in. on Aug. 26. Another gage about ten miles downstream recorded 4.68 in. on the same date. Unfortunately stream flow records in this district are not available, although at Rosendale, N. Y., about twelve miles below the flooded section, the flow of Rondout Creek reached a maximum of 27,500 sec.-ft. The drainage area of the stream above the gaging station, which is maintained jointly by the U. S. Geological Survey and the Central Hudson Gas & Electric Corporation, is 365 square miles, and the normal flow of the stream about 1,250 sec.-ft.

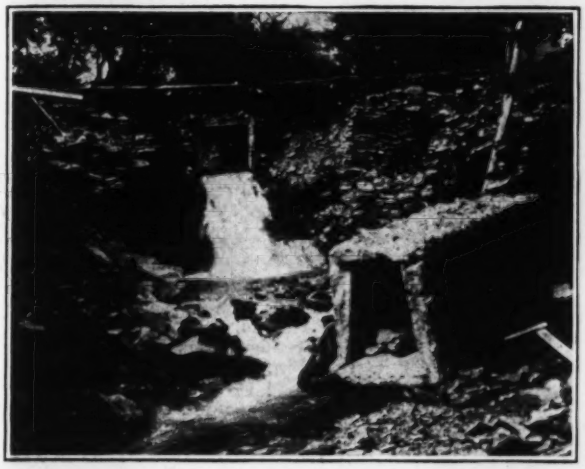
Damage was suffered by houses, bridges and roads along the twelve-mile narrow valley which received the full force of the flood. A number of automobiles caught in the valley were destroyed, and three deaths by drowning are reported. A road paralleled the creek on each side, and there were numerous connections between these roads by bridges of steel, concrete and timber. Of eleven bridges between Grahamsville and Napanoch only two remain intact. Both of these are steel trusses, one of which crossed a rocky gorge well above the flood level. One road, paved with bituminous macadam, is washed out in several places, but is still passable; the other, of gravel type, has been almost completely obliterated in many places. The usual form of bridge failure was by an abutment washout or undermining, although eyewitnesses state that several timber bridges were floated away by the water. In these cases, however, it is noted that the abutments which remain are badly damaged, and the exact cause of destruction is rather uncertain.

The destructive force of the water is shown by the way in which it completely washed out and destroyed several sections of compact bituminous macadam road. Not only was the surface paving broken up and disintegrated, but the coarser material down to the telford base has completely disappeared.

Below Napanoch, as already stated, the damage was inconsiderable. One wooden covered bridge of the old-fashioned type was undermined so that it fell bodily into the stream several days after the flood had subsided. Several miles of new concrete road were submerged, but sustained no harm except minor shoulder washouts. Part of the track of the New York, Ontario & Western Railroad was undermined, but this was quickly repaired and traffic was resumed the day after the flood.

Western State Engineers Form Association

Announcement has been sent out that the Association of Western State Engineers will hold its first annual meeting in Salt Lake City, Utah, Oct. 29-31. Delegates have been named from seventeen states, in most cases consisting of or including the state engineer, according to George M. Bacon, state engineer of Utah, who is acting secretary of the organization. A two-day program of addresses has been arranged and a third day is to be devoted to visiting points of interest in the vicinity of Salt Lake. The states included are Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Wyoming and Washington.



FLOOD DAMAGE TO ROADS AND BRIDGES IN THE RONDOUT VALLEY, NEW YORK

TOP—Where state highway crossed Rondout Creek at Napanoch, N. Y. The steel bridge was carried away completely. Note how the far abutment was circled by the stream.

MIDDLE—Culvert failure near Grahamsville, N. Y. This 4x6-ft. concrete box culvert failed to carry the discharge from a small tributary of Rondout Creek. A gage less than one mile away recorded 6.81 in. of rainfall.

BOTTOM—Section of bituminous macadam road completely disintegrated.

TOP—Concrete-incased steel bridge undermined by flood at Montela, N. Y.

MIDDLE—Concrete bridge undermined and cracked, and approach highway of bituminous macadam washed away near Eureka, N. Y.

BOTTOM—The one bridge in twelve miles of valley which survived the full flood without damage. Although it did not cross the main stream, this steel truss with concrete deck was completely submerged by the waters of Rondout Creek. The water flowed parallel to this span.

William L. D'Olier Found Dead

The body of William L. D'Olier, president of the Sanitation Corporation, New York City, builder of screens and other sewage-works appliances, was found dead at a lonely spot near Maspeth, Long Island, early in the morning of Sept. 2 from a bullet wound in the head. Mr. D'Olier was soon to testify a second time in the investigation of alleged excessive sewer construction costs in Queens Borough, in progress for months past. He is the third important witness in this case to die since the investigation was started, the others being George A. Reading and J. M. Phillips. The Sanitation Corporation was sub-contractor for screens in the Bergen Point and Rockaway sewage-works, Borough of Queens, New York City.

Mr. D'Olier was born in Philadelphia in 1872. From 1889 to 1894 he was with William D'Olier & Company, merchants, engaged in the application of electricity to textile works. From 1895 to 1911 he was with first the D'Olier Electric Company, as chief engineer and president, then with the D'Olier Engineering Company. During this period he installed electrical and mechanical equipment for many industrial plants and public works, including the Philadelphia water-filtration plant, New York State Barge Canal, the Panama Canal and the U. S. Reclamation Service and high-pressure fire pumps at Brooklyn, N. Y.

From 1914 to the date of his death Mr. D'Olier was, first, chief engineer, then president of the Sanitation Corporation, which installed Riensch-Wurl screens at Daytona, Fla., Rochester, N. Y., and elsewhere, including those now involved in the Queens Borough investigations. Mr. D'Olier was also president of the D'Olier Centrifugal Pump & Machinery Company.

Public Lands Available for Airport Construction

The U. S. Department of the Interior has drafted regulations governing leasing of public lands for airports and aviation fields, thereby making it possible that land still in the possession of the government shall be used for this purpose as provided by Congress. Application for areas not exceeding 640 acres may be made directly to the department and will be passed upon by both the Department of the Interior and the Department of Commerce. The leases will be for a twenty-year term, at a fee of $10 per year, with the privilege of extension under certain conditions. The government reserves the right to terminate the lease if the holder fails to use the premises for airport purposes or otherwise fails to live up to the regulations. Airports must be equipped within six months.

Ready to Spin Cables for Mount Hope Bridge

Erection of two temporary platforms for footbridges to be used in spinning the cable for the Mount Hope suspension bridge in Rhode Island has been completed, and work on the cables will start in the near future. They are to be constructed of parallel wires and will be spun in place.

Report Disapproves 9-Ft. Channel on Upper Mississippi

As the result of an investigation by the U. S. Engineer Corps, Rock Island district, the proposed deepening of the Mississippi River channel to a 9-ft. depth from Grafton, Ill. to Minneapolis, Minn., has been reported adversely to the War Department. The report was presented by Major C. L. Hall, who states that the principal grounds upon which the adverse conclusions are based are that the maximum savings per ton-mile due to transportation on a 9-ft. depth over those due to transportation on a 6-ft. depth, multiplied by the potential ton-mileage, are insufficient to repay the minimum cost of the proposed improvement.

Publication of the report has raised a number of protests along the Mississippi Valley, and it is expected that an appeal from the conclusions of the report will be made to the board of engineers for rivers and harbors at Washington, D. C.

To Discuss Traffic Control

The Engineers Club of Philadelphia, has arranged a meeting for Tuesday, Oct. 16, for a discussion of the topic, "Expediting and Controlling City Traffic." Sessions will be held both in the afternoon and in the evening, and dinner will be served in the clubhouse between the sessions. The program thus far arranged is as follows: "Difficulties in the Way of Efficient Street Use," Dr. Miller McClintock, director, Erskine Bureau for Traffic Research, Harvard University; "Organization and Functioning of a City Traffic Engineering Bureau," Burton W. Marsh, traffic engineer, Pittsburgh; "Requirements Essential to Adequate Street Transportation," H. M. Lewis, executive engineer, Regional Plan of New York; "The Function of Street Railway and Bus Lines in the Transportation System," J. Rowland Bibbins, consulting engineer, Washington, D. C.; "Where Shall They Park?" Hawley S. Simpson, traffic engineer, Essex County, Newark, N. J.; "The Pedestrian — Education and Safety," Sidney J. Williams, director, National Safety Council, Chicago; "The Trend of Traffic Signaling," G. G. Kelsey, traffic engineer, American Gas Accumulator Company, Elizabeth, N. J. The secretary of the Engineers Club of Philadelphia, Charles E. Billin, announces that he will send further details of the meeting to any engineer who is interested in the subject of city traffic.

War Department Approves Several Bridge Plans

Several important structures were included among the bridges recently approved for construction by the U. S. War Department. Two spans across the Ohio will be permitted; one at Ashland, Ky., the other at Madison, Ind. In addition, the long-standing dispute concerning the new bridge across the Passaic River to carry the approach highway to the Holland tunnels was settled by War Department authorization to construct two new bridges 100 ft. apart across the Passaic River in New Jersey. One will carry the Lincoln Highway, the other the

ARCHITECT'S DRAWING OF WASHINGTON ST. BRIDGE, ACROSS SEEKONKRIVER, PROVIDENCE, R. I.

Construction has begun on the new Washington St. Bridge across the Seekonk River connecting Providence and East Providence, R. I., which will replace a steel structure built in the early '80s. The new structure consists of twelve concrete arches and one 150-ft. steel bascule lift span with a total length of 2,408 ft. A 60-ft. roadway carrying two street-car lines will be flanked on both sides by a 10-ft. sidewalk. The approaches span two cross streets and the tracks of the New York, New Haven & Hartford Railroad. Granite block facing, used throughout, and 40 ornamental standards carrying bronze lanterns will add to the architectural beauty of the bridge. Clarence W. Hudson, consulting engineer, New York, designed the structure. Merritt-Chapman & Scott Corporation, New York, has the contract for the construction of the foundations and superstructure at a contract price of $2,984,000.

new approach road to the tunnels known as Route 1 extension. The New Jersey State Highway Department had advocated a separation of 175 ft., while the New Jersey State Board of Commerce and Navigation wished to secure unified operation of the two bridges by placing them 85 ft. apart. The compromise distance of 100 ft. has been approved by the War Department, and it is expected that the two state departments concerned will agree.

Shipping Terminal to Be Built at Rock Island

Approval of Rock Island, Ill., as the site for the proposed tri-city terminal of the Inland Waterways Corporation has been given by the acting Secretary of War, C. B. Robbins, as the result of a report made to Major Gen. T. Q. Ashburn, chairman of the Inland Waterways Corporation, by Walter F. Schulz, consulting engineer for the corporation. This terminal will serve the three cities of Rock Island and Moline, Ill., and Davenport, Iowa. The decision was reached following a series of hearings at which representatives of the three cities presented arguments.

Meeting of the American Public Health Association

The annual meeting of the American Public Health Association is scheduled for Chicago, Ill., Oct. 15-19. During the five sessions the following questions will be discussed: Milk supply and sanitation, sewage disposal, sewerage and water systems, the disposal of phenol waste, the financing of water-supply and sewerage projects, and research in sewage and industrial waste. An elaborate series of inspection trips is planned, including visits to the Chicago experimental water-filtration plant, the new North Side sewage-treatment works, the West Side sewage plant, now under construction, the Chicago Ave. tunnel and the Goose Island incinerator.

Two Small Buildings Utilize Arc Welding

A one-story structure approximately 35x100 ft. involving Fink-type trusses supported by 6-in. 20-lb. H-section columns has been fabricated by electric arc welding in the shops of the Republic Structural Iron Works, Cleveland, Ohio, for the Thew Shovel Company, Lorain, Ohio. In the trusses gusset plates were eliminated, except at the bearing ends and at the hip. The only punching required was for the bolted field connections. On the columns the base plates and caps were welded. Another building has recently been entirely arc welded by the Lang Portable Welding Company at Cuyahoga Falls, Ohio. This is a standard shop-type building with center monitor on which the steel work was delivered to the job cut to proper size and all fabricating was done in the field. No bolts or rivets were used either in fabrication or in erection.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Flood-Control Report Approved—Will Build Hangars at Panama—Missouri River to Be Deepened

APPROVAL by the President of the report of the board of three set up to harmonize the engineering differences in the plans for flood control on the Mississippi River has been a signal for protest meetings among those who oppose the diversions through Louisiana. There is strong demand for a masonry spillway instead of a levee of the fuse-plug type. At the Corps of Engineers, attention is called to the fact that the masonry spillway proposed by the Mississippi River Commission would begin to operate at a stage 6 ft. lower than the present levee or the fuse-plug which has been approved by the President.

The President excepted from his approval the paragraphs relating to compensation for damages and payment for flowage rights. The board held that the provisions of the law to that end would require legal interpretation. Members of Congress took exception to that conclusion on the ground that the language of the act was plain in directing damage payments and purchase of flowage rights. The action of the President in withholding approval of that portion of the report will have the effect of having this feature reviewed by the Attorney General rather than by the law officers of the War Department.

Power License Protested

A protest against the issuance of a license to the Porto Rico Railway & Light Company has been filed with the Federal Power Commission by M. Argueso. He contends that the license covers all water power of value in the island and will give the company an absolute monopoly in the matter of large-scale power development. The commission is awaiting a statement of pre-license costs from the Porto Rico company and will take no action on the application for license until such a statement has been approved.

Canal Zone Airport

The Bureau of Yards and Docks of the Navy Department will open bids on Sept. 5 for the construction of a hangar at the Coco Solo air station in the Canal Zone. This is in connection with a five-year program for the improvement of the air station, to provide for the permanent housing of 90 planes and storage facilities for 513 planes assigned to the fleet. A contract has already been awarded for the construction of one hangar and work is now in progress. Plans and specifications will be completed in the near future to permit advertising for bids on the construction of housing facilities. The act of Congress authorizing the construction provides an appropriation of $1,431,000. This sum provides $240,000 for officers' quarters, $144,000 for quarters for married chief petty officers, $400,000 for barracks and mess hall construction, $90,000 for an engine overhaul shop, $187,000 for a general storehouse and $370,000 for the two hangars. It is planned, ultimately, to provide accommodations at the station for 700 men.

Wind Pressure Allowance

The navy now is providing for 65 lb. of wind pressure in designing buildings in Florida and Cuba. In a report on the subject, Rear Admiral F. R. Harris expresses himself as convinced that provision must be made to withstand wind velocities of 140 to 150 m.p.h.

Navigation Improvements

The Secretary of War has approved an allocation of $800,000 for the channel improvement project in the Missouri River from Kansas City to its mouth. There is, in addition to this sum, an unexpended balance of $3,885,000 on hand for this work, of which amount slightly more than two-thirds is obligated by operations now under way or under contract. More than a million dollars of contract work is already in progress. The work being done by day labor amounts to $1,100,000. This river improvement project, involving a distance of 389 miles, provides for a minimum depth of 6 ft. and a minimum width of 200 ft., with slightly wider channels at sharp bends. The work consists for the most part of bank revetment operations, the construction of permeable dikes, snag removal and occasional dredging. The policy of the Corps of Engineers in the execution of the Missouri River project, as shown by communications sent to the districts above Kansas City, is to complete the work by stages proceeding gradually up stream.

European Briefs

Compulsory Registration of all unemployed persons is now required in Italy. The government is setting up official employment bureaus in all parts of the country to which must be reported the names of all workmen hired or discharged. It is forbidden to employ any person who is not registered at the government employment bureaus, and penalties are to be imposed upon both workmen and employer for violations.

Construction of Skyscrapers has not been allowed in Germany and the highest houses built in after-war years were those of Düsseldorf, Cologne and a few other west German cities with 12-14 floors. Now, however, after repeated applications, the Berlin municipality and a few other German towns

have given permission for the construction of office buildings with 18-22 floors. Such buildings will shortly be erected at Berlin, Hamburg, Leipzig and other places. As construction material high-silicon steel will be used, which affords lighter building and has given excellent results in bridge construction.

CONSTRUCTION of the largest railway and general traffic steel bridge in southeast Europe over the Danube River near Pancsevo, a few miles distant from Belgrade, has just been started. The builders are the United Steel Works, Germany. The bridge will have a total length of 1.1 miles and will cross the river in three spans. The cost will be approximately $5,300,000.

THE GREEK GOVERNMENT, which some months ago commenced extended drainage work in Macedonia aided by a loan by British and American firms, has again started negotiations with American and British bankers to get a loan which shall be used for extensive drainage and canalization work in the Strymon Valley. The Greek government has expressed willingness to award the contracts to the countries which will provide the loan. The estimate of the cost of the works is $20,000,000.

THE OLD CANAL between Dortmund and the Ems River, Germany, which connects this important industrial area with the chief German shipping ports, will be enlarged and made navigable for ships of the size carrying the traffic on the Rhine. The costs will be approximately 210,000,000 marks. Work will be finished within four years. Surveys have been already completed for the project.

GERMAN ENGINEERS are now sailing to Australia, where, under the organization scheme of Bergbau A. G., the first Australian brown coal mines will be developed. The mines, situated at Yallourn, Victoria, will serve as a fuel source for the Morwell electric power plant and will produce from 6,000 to 10,000 tons of brown coal daily. The machinery has been bought in Germany. A part of the coal will be used later on for the coal distillation according to German brown coal distillation patents.

THE PORT OF COLOGNE on the Rhine will be finished in 1930, and will then be the largest inland port in Europe. The port will assist the German coal, steel and other industries in their world shipping problem. It is expected the port of Cologne will handle about three-fourths of the traffic now handled at Hamburg.

FRENCH BUYING POWER is very low. With the lowest bracket on the income tax at 7,100 francs (about $300 gold), only 1,829,943 paid income tax in 1927, or one in twenty of the population. Of these taxpayers 93 per cent had an income equivalent to $2,000 or less. In view of the high level of commodity prices it is doubtful whether these people are saving any appreciable amount of their income, despite the traditional French thrift. Based on a level of 100 in July, 1914, prices of twenty representative foods had an index of 593 on April, 1928. The corresponding figure for industrial materials is 674, for textiles 759. When reduced to a gold basis, however, the indexes indicate that France is better off than other European countries. (Commodity price levels for France, 115; for Great Britain, 162; for Germany, 152.)

Engineering Societies

CALENDAR

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Montreal, Canada, Sept. 18-21.

NATIONAL SAFETY COUNCIL, Chicago: Annual Meeting, New York City, Oct. 1-5.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Fall Meeting, San Diego, Calif., Oct. 3-5.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Convention, Detroit, Mich., Oct. 22-28.

THE BOSTON SOCIETY OF CIVIL ENGINEERS is planning a highway inspection trip to take place Sept. 15. The first regular meeting of the fall season will be held on Sept. 26, at which will be discussed "The Engineer's Duty in Acquiring Land for State, Municipal or Public Utility Developments."

Personal Notes

Rear Admiral L. E. GREGORY, chief of the Bureau of Yards and Docks, has returned to Washington after having completed an extensive inspection tour of Western navy yards and naval stations. During this trip he spent considerable time at the site for the new ammunition depot that is being erected at Hawthorne, Nev.

A. L. ALIN, formerly with Stevens & Koon, consulting engineers, Portland, Ore., has been appointed supervising engineer on the dam and power house of the Leaburg power development now being constructed by the city of Eugene, Ore. Mr. Alin was formerly engaged in the design of this dam and power house while with Stevens & Koon.

JOHN E. FOOTE has been appointed to the city lands commission of Utica, N. Y., to fill the unexpired term of Gay H. Brown. Mr. Foote was formerly deputy city engineer of Utica.

Capt. H. R. STANFORD, of the engineer corps of the navy, has returned to Washington from temporary duty at the Boston and Portsmouth navy yards. He has been making a survey of the central power plants at these stations in connection with the navy's plan to improve the efficiency of its power generation.

WILBUR H. FISHER, of Frankfort, Ky., has resigned as bridge designer for the Kentucky State Highway Department to accept the appointment as bridge engineer for the Wyoming State Highway Department at Cheyenne, Wyo.

GLOSTER WELLER, past-president of of the Rochester Engineering Society, has been named as one of a committee of five appointed by the mayor of Rochester to develop a city plan.

C. E. PLUMMER has been appointed chief chemical and metallurgical engineer for the Robert W. Hunt Company, Chicago.

Obituary

ISAAC E. CHAPMAN, retired president and director of the Philadelphia Derrick & Salvage Corporation and one of the founders of the Merritt & Chapman Derrick & Wrecking Company, died on Aug. 29 at Greenwich, Conn., at the age of 67. When the latter organization became the present Merritt-Chapman & Scott Corporation in 1922 Mr. Chapman became vice-president and director until his retirement in 1924.

DAVID J. HOWELL, consulting engineer, of Washington, D. C., died on Aug. 28 of heart disease at Alexandria, Va. He was 62 years old. Mr. Howell was senior member of the firm of D. J. Howell & Son, engineers, was formerly chief engineer of the Arlington County, Va., Sanitary District, and had at one time worked on surveys for the New York State Barge Canal. He was a member of the American Society of Civil Engineers and of the American Water Works Association.

C. KEMBLE BALDWIN, chief engineer of the Robins Conveying Belt Company, died on Aug. 9. During the 30 years of his active career, Mr. Baldwin was responsible for a number of improvements in conveying machinery and also for the introduction of such machinery into many new fields. He was a member of the Western Society of Engineers.

W. P. CHAPMAN, assistant construction engineer of the Minnesota State Highway Department, died recently from injuries received when struck by an automobile. He was 36 years old and had been engaged in highway work since his graduation from the University of Minnesota in 1914.

HERMAN DAVIS GRADON, aged 73, former city engineer of Portland, Ore., dropped dead at his home in Madera, Calif., Aug. 28.

Construction Equipment and Materials

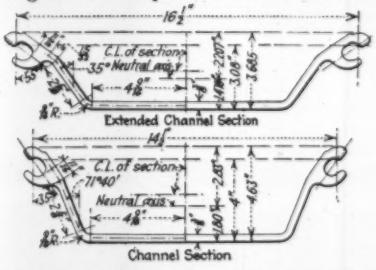
International Exposition to Be Held in Barcelona, Spain

From April to December, 1929, an international exposition of art and industry will be held in Barcelona, Spain. This exposition and the Ibero-American exposition at Seville will be a joint demonstration of Spanish activity. The exposition is under the auspices of the Spanish government, and is managed by a local directorate in Barcelona. The industrial division, perhaps the greatest aspect of the exposition, is planned to cover the products of all countries. Civil, military and naval engineering will be considered in separate departments, as well as exhibits of engineering and architectural materials. All methods of transportation engineering are also included in the plan. Detailed information with regard to placing and arranging exhibits may be obtained from the "Exposition of Barcelona, Delegate to the United States, Steinway Hall, New York City."

New Developments

New Steel Sheet Piling Sections Effect Saving in Weight

A new steel sheet piling section has been developed by the Jones & Laughlin Steel Corporation, Pittsburgh, incorporating an improved double lock. The lock is claimed to give not only great tensile strength but unusual watertight qualities and ample clearance for free driving. Another feature of the sections is their light weight, the manufacturer claiming a saving of 20 per cent in weight over comparable sections now on



the market. All sections have a uniform thickness of metal of ⅜ in. There are six new piling sections planned, but only two of them are being introduced at the present time. These are shown in the accompanying illustrations. The channel section, designated C-27, weighs 27 lb. per sq.ft. of wall and has a section modulus per 12 in. of width of 6.64 in.³ which is claimed to be the highest section modulus possible, considering the weight of materials used. The extended channel section designated as E C-23.75 weighs 23.75 lb. per sq.ft. of wall and has a section modulus per 12 in. of width of 4.71 in.³ The section modulus per linear foot of wall interlocked is 9.18 in.³ for the extended channel section and 14.34 in.³ for the channel section. The four other sections which are planned will vary in weight from 22 to 31 lb. per sq.ft. of wall.

All of these various sections can be interchangeably interlocked, thus making it possible to drive sections of high section modulus where necessary, and to connect to them more flexible sections where these are needed. Four EC-23.75 sections can be used for corner with the C-27 sections, and four C-27 sections for corner with the EC-23.75 sections. Fabricated corners weigh 54 lb. per foot and fabricated tee piles 70 lb. per foot.

Portable Electric Saw for Heavy Construction Use

A new portable electric saw suitable for such work as bridge building, dock building, ship building and all construction work where heavy lumber is used has been added to the line of portable electric- and air-driven saws made by the Crowe Manufacturing Corporation, Cincinnati. This new model is known as CC-16. It is said that at a recent demonstration one man operating this saw cut through a 14x6-in. oak timber in twenty seconds.

The body of the tool is made of aluminum alloy. The blades are of specially treated steel, and are claimed to retain their cutting edge even when filed down almost to the revolving hub. Special blades are provided for cutting soapstone, wallboard, marble, limestone and other materials. The Crowe safety guard is used on this new saw, as on all of the other models. The company now manufactures the saws in five sizes, 1½ in., 2½ in., 3 in., 4⅛ in. and 6⅛ in., respectively.

A New 13-E Paver for the Medium-Sized Job

A new paver well adapted for city paving, for alleys, small country roads, sewer work or other jobs requiring a portable medium-sized mixer has been developed by the Ransome Concrete Machinery Company, Dunellen, N. J., in its new 13-E mixer. This size machine falls between the company's 10-E and 27-E. In quality of workmanship it is claimed to be built up to the high standards of the company's 27-E paver. All levers are within easy reach of the operator, and a special feature is the all-steel mixing drum with locomotive tires for tracks, and flanged car wheels for rollers equipped with Timken bearings.

The machine is equipped with crawlers 9 ft. center to center of end wheels; a power loader which is claimed to raise the 91-in. wide skip to a 52 deg. slope in 8½ seconds; a batch meter; and a power plant consisting of a four-cylinder 30-hp. Buda engine. The water tank is 24 in. in diameter by 32 in. high set vertically. It is equipped with an adjustable displacement tank which is claimed to measure accurately any amount of water between 8 and 25 gal. Adjustment is made by a hand wheel. The water valve is of the balanced piston type with cut leather packing. The inlet piping is 2 in. and the discharge pipe 2½ in.

The over-all length of the machine with boom is 40 ft. 9 in. and its width with the operator's platform is 10 ft. 10 in. Its height over all is 12 ft. 5¾ in. and with the loader raised 18 ft. 4¾ in. The weight of the machine with boom and bucket is 25,000 lb. Alemite lubrication is used throughout.

Pneumatic Clay Diggers for Light and Heavy Work

Separate models of pneumatic clay diggers for light and heavy work have been brought out by the Independent Pneumatic Tool Company, Chicago, Ill., manufacturer of Thor electric and pneumatic tools. Both are of the valveless type, the piston forming the valve. The Thor No. 201 is recommended for trimming, soft clay digging and overhead work in tunnels. It weighs 24¾ lb., has an over-all length of 31¼ in., strikes 2,800 blows per minute and has a 1½-in. stroke. The Thor No. 202 clay digger has been designed for hard digging. It is 1 lb. heavier, 1 in. longer, strikes 2,200 blows per minute and has a 2-in. stroke. Both machines have a bore of 1 1/16 in. It is claimed that, due to the arrangement of the exhaust ports, all danger of freezing has been eliminated.

New Power Hoist for Use on Light-Weight Trucks

A new hydraulic hoist has been developed by the Heil Company, Milwaukee, Wis., and is now available as its model H-2 Hydro-Hoist. Among the advantages claimed are quick operation, high dumping angle, easy installation and removal, accessibility and freedom from racking of the truck body.

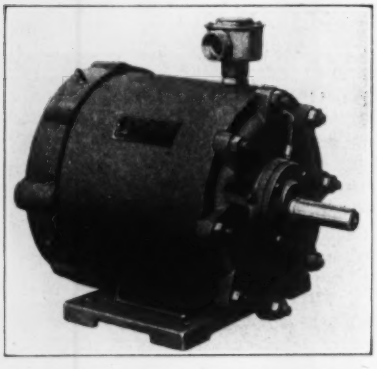
A dumping angle of 56 deg. is possible, and the hoist will dump a full load in from 5 to 9 seconds, depending on the

speed of the motor. The hoist, which comes assembled as a unit on a special sub-frame, is fastened to the truck chassis by four U-bolts. Removal of the four U-bolts, a matter of a few minutes work, makes it possible to remove the hoist and body as a unit, so that the truck can be used for other purposes. For servicing, the removal of one nut disconnects the lifting arms. The hoist can then be tipped back against the cab, where it is out of the way.

The model H-2 hoist is built on the same gear principle as the Heil Company's heavier units, and is tested to several times its lifting requirements at the factory. It will easily carry a 6,000-lb. load.

Self-Ventilating Motor Approved for Hazardous Location

A self-ventilating explosion-proof motor, known as type Ex, has been developed by the Louis Allis Company, Milwaukee, Wis. It is now available for alternating current up to 5 hp. and will soon be available in larger units



up to 10-hp. capacity. This motor has been approved by the Underwriters Laboratory for operation where gasoline, naphtha, oil or other petroleum products are made, used or handled. It is stated that this motor can be mounted with little or no special arrangements on a machine designed for the standard open-type motor.

Manufacturers and Trade Associations

CALENDAR

ANNUAL MEETINGS

TRACK SUPPLY ASSOCIATION, Chicago; annual exhibition and convention, Detroit, Sept. 18-20, 1928.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; semi-annual meeting, Buckwood Inn, Shawnee-on-Delaware, Pa., October 1-3, 1928.

New Publications

Welding Equipment—GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has published four new bulletins describing various welding equipment which it manufactures. Bulletin 569-A illustrates and describes constant-potential arc-welding sets, suitable for furnishing power to a number of welding stations and for operating automatic welding equipment. Bulletin 823-A describes the atomic hydrogen arc-welding equipment for hand welding on 50- and 60-cycle circuits. Bulletin 874 describes the company's type WD-200-A arc-welder mounted on a steel three-wheel truck to be used particularly in industrial plants or repair shops. Bulletin 881 describes the company's gas engine-driven arc welder with a current range of from 50 to 300 amp. The latter equipment is mounted on a four-wheel truck.

Truck Cranes—MOTT & MCELRATH ENGINEERING CORPORATION, New York, N. Y., has issued a descriptive booklet about the Ersted truck crane. This gives complete specifications, including hoisting radius diagram, as well as several pictures showing the crane at work.

Centrifugal Pumps — MORRIS MACHINE WORKS, Baldwinsville, N. Y., has put out a twelve-page booklet describing the Morris line of pumps as applied to sand and gravel production. It is called Bulletin 129.

Spray Cooling Equipment—POWER PLANT EQUIPMENT COMPANY, Kansas City, Mo., has published a useful book of 24 pages which not only describes the Marley line of spray cooling equipment produced by the company but also gives many valuable data on the design and layout of cooling installations, including a number of useful charts and tables.

Testing Machines — RIEHLE BROS. TESTING MACHINE COMPANY, Philadelphia, Pa., has issued a readable booklet called "Evolution of the Testing Machine" which tells in narrative form the development of testing machines since the construction of the first model in 1886.

Electric Welding — THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has issued a booklet describing the Electronic Tornado process of welding recently developed and giving tables showing the time and cost of automatic arc welding different thicknesses of metal for different joints. Illustrations show several applications of automatic welding machines using the new process.

Explosives—E. I. DU PONT DE NEMOURS & COMPANY, Wilmington, Del., have issued a new and revised edition of the "Blaster's Handbook." The volume was prepared under the direction of Arthur La Motte, manager of the technical section. It contains 214 pages and is of handy pocket size. Among important new matter which appears is a section devoted to description of the character and uses of pellet powder, a relatively new type of explosive so far as the United States is concerned, which offers many advantages for use in coal mines where permissible explosives are not needed. There is also description of the low-density extra dynamites, which are designed to reduce explosives costs in blasting soft ore, soft limestone, salt, gypsum and clay; and of Agritol, a similar explosive for agricultural blasting. The section on electric firing shows a new type of delay electric blasting cap and gives examples of the method of calculating the electric current required for firing various types of blasting circuits. The sections devoted to ore mining, coal mining and tunneling have been revised to include various new practices developed. Especially interesting is the discussion of methods of safeguarding electric firing underground against the hazards of premature application of the current to the blasting circuit and of the passage of stray current into the circuit.

Air Compressors — SULLIVAN MACHINERY COMPANY, Chicago, Ill., describes its new 8-in. stroke angle compressor in bulletin 83-K. This model is built on the same principles and design as the larger angle compound machine and extends to machines as small as 300-cu.ft. displacement capacity. The booklet gives a detailed description of the machine, as well as complete specifications. It is well illustrated by views showing various details.

Recording Instruments — JULIEN P. FRIEZ & SONS, Baltimore, Md., have issued a folder giving full description of the indicating and recording machines manufactured by the company for use in hydro-electric plants and waterworks. Included in the pamphlet is a full-sized reproduction of a record obtained from one of the instruments in actual service.

Excavating Machinery—THE BYERS MACHINE COMPANY, Ravenna, Ohio, has issued two new catalogs, one describing the Byers master shovel of 1- to 1¼-cu.yd. capacity; the other, the Byers Bear Cat, a ⅝-cu.yd. full revolving gas shovel. Each catalog contains complete descriptions, mechanical working views and general specifications.

Paints — CHEESMAN - ELLIOT COMPANY, INC., Brooklyn, N. Y., pays particular attention to the problem of securing low visibility in gas holders by the use of Ceco technical paints in a recent special bulletin. Another phase of the same problem is treated in a bulletin on color harmony. Besides these two publications, a 12-page booklet describes Newlite interior white, a special paint for use where a glossy white finish is desired.

Airports and Aviation Buildings—THE AUSTIN COMPANY, Cleveland, Ohio, has inaugurated a complete service for designing and building aviation projects which is described in a recent publication of the company. Among the functions of the organization which are described are the layout and design of airplane factories, hangars, service buildings and airport facilities.

The Business Side of Construction

August Lettings Slightly Greater Than a Year Ago

Volume 17 Per Cent Over Last Year —Capital Issues Indicate Continued Prosperity

CONTRACTS were let in August at the rate of $73,500,000 worth per week, compared with $64,000,000 in July and $72,300,000 in August, 1927. The total for the five weeks of August is $367,563,000, compared with $256,115,000 for the four weeks of July. The increase is spread quite evenly throughout the country, and all classes of construction participate.

The increase in total value of construction contracts awarded this year over that of the first eight months of 1927 is 17 per cent this is the same percentage of increase that prevailed for the first seven months of the year over the corresponding seven months of 1927. This increase is accounted for principally by heavy lettings of streets and roads and buildings. Street and road lettings are $115,000,000, or 34 per cent, heavier than last year. Industrial buildings awards are 16 per cent heavier and other building awards exclusive of small residential work are 15 per cent heavier. The value of unclassified contracts is 24 per cent under that of a year ago. Small declines are shown in water-works, sewers and excavations.

Except for a 40 per cent increase in the Middle Atlantic states, the geographical distribution of contract awards is quite even. The New England total is $166,000,000, compared with $163,000,000 in 1927. The South reports $179,000,000, compared with $151,000,000 a year ago. There has been a $100,000,000 gain in the Middle West and a $7,000,000 decrease in the region between the Mississippi River and the Rocky Mountains. The West coast reports $224,000,000, compared with $248,000,000 in 1927.

What are the prospects for continued heavy contract letting in the next few months? Examination of the volume of new capital issued this year compared with last provokes some interesting thoughts but provides insufficient data upon which to base a prediction. As there appears to be a lag of four months between the issuance of new capital for construction and the award of contracts for this construction, the volume of new capital issued in April, May, June and July of 1927 will be compared with the value of contracts awarded in August, September, October and November of that year. This capital totals $1,716,000,000 for contracts which totaled $1,086,000,000, or 63 per cent of the value of capital. New capital issued in April, May, June and July of 1928 has totaled $1,999,000,000, and if the same proportion of this goes into engineering-construction contracts that went last year, the value of such contracts for August, September, October and November, 1928, will amount to $1,259,000,000. Of this hypothetical amount, $368,000,000 was awarded in August, leaving $891,000,000 to be awarded in September, October and November, compared with $797,000,000 actually awarded in those three months in 1927, if the 1927 proportion of contracts to capital issues is to be maintained.

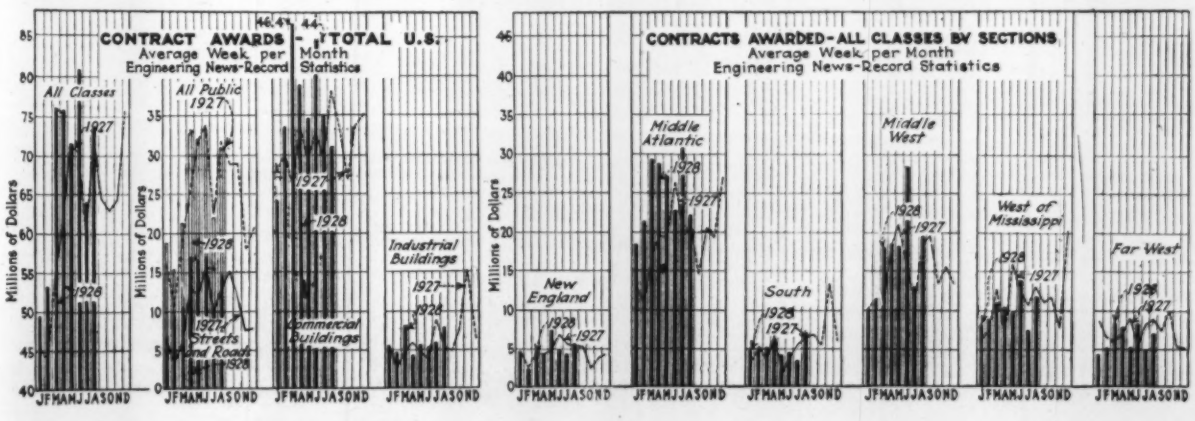
This demands that value of contracts awarded in the next three months amount to 12 per cent more than in the corresponding three months in 1927. In view of recent past performances, the attainment of such a bogey is by no means impossible. New capital issued in June, and still unused, was the largest amount on record. Set against this is the fact that issues in July were the lowest for that month since 1924 and amounted to only 44 per cent of the June total, whereas the July, 1927, figure amounted to 64 per cent of the June, 1927, total. Furthermore, August also is a seasonably low month and has always registered a decline from July. The volume of capital issued in the next few months, therefore, will bear close watching as an index of construction volume during the remainder of the year.

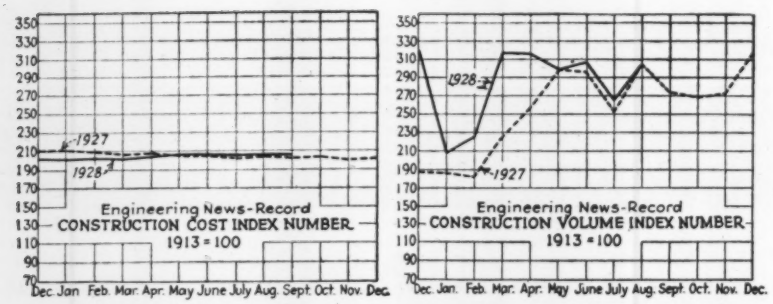
The first chart on p. 372 shows three-month moving averages of new capital issues (minus refunding bonds) and of construction contracts from 1924 to date.

VALUE OF CONTRACTS BY SECTIONS IN THE UNITED STATES AND TOTAL FOR CANADA, AUGUST, 1928

Thousands of dollars (-000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date, U. S.	Canada
Waterworks	$90	$773	$80	$837	$706	$103	$2,589	**$36,359**	$81
Sewers	247	2,062	1,462	4,058	2,601	3,013	13,443	**69,712**	386
Bridges	167	2,442	2,004	2,472	2,646	661	10,392	**87,439**	242
Excavations, drainage, etc.	46	577	840	4,765	396	250	6,874	**23,239**	3,865
Streets and roads	4,218	17,392	12,462	18,062	13,126	8,202	73,462	**448,688**	1,442
Industrial buildings	5,902	6,395	9,850	9,760	5,697	2,083	39,687	**209,990**	3,385
Commercial buildings	15,441	70,826	7,964	52,375	20,308	16,400	183,014	**1,309,704**	3,980
Federal government	557	1,097	3,344	3,397	1,974	4,339	14,708	**42,997**	.....
Unclassified	25	9,282	245	1,367	11,732	743	23,394	**169,486**	2,068
August, 1928	26,693	110,846	38,251	96,793	59,186	35,794	367,563	.....	15,449
July, 1928	17,031	123,358	13,007	51,827	30,782	20,110	256,115	.....	15,008
August, 1927	20,430	83,025	25,843	73,773	51,095	35,178	289,344	.....	13,227
Year to date, 1928	**165,511**	**877,840**	**178,552**	**596,682**	**355,225**	**223,804**	.....	**2,397,614**	**107,004**
Year to date, 1927	162,509	624,235	151,304	496,608	361,879	248,438	2,044,973	.....	76,415




1927
1928
Engineering News-Record
CONSTRUCTION COST INDEX NUMBER
1913 = 100
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1928
1927
Engineering News-Record
CONSTRUCTION VOLUME INDEX NUMBER
1913 = 100
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

ENGINEERING NEWS-RECORD CONSTRUCTION COST AND VOLUME INDEX NUMBERS

The contract figures are plotted four months behind those for capital—for example, January capital corresponds with May contracts.

Cast-Iron Pipe Down $1 Per Ton; Other Prices Firm

Most of the basic construction materials show tendency toward price increases this month, due to active demand and limited production. Cast-iron pipe is an exception, its price having dropped $1 per ton at Burlington mills, affecting all f.o.b. points in the Northeastern territory.

The tone of the cement market has stiffened in most of the large buying centers. In addition to no price reductions, the Alpena and Wyandotte mills (Mich.) have advanced prices 5c. per barrel. These mills supply Detroit, where a similar advance is recorded.

In New York City and Chicago dealers report unusually keen competition. These cities are the chief cement users, consuming annually 10,000,000 and 6,000,000 bbl. respectively. Prices, however, remain the same as they were during the last year and more.

Structural steel buying in the Pittsburgh district is seasonally quiet, although several fabricators report bookings sufficient to keep busy for months ahead. Inquiries are active, while actual ordering is slow. The Pittsburgh price on large mill lots of shapes, plates, etc., is $1.85—the same since June. At this time last year the price was about the same, $1.80@$1.85. Production shows a slight gain over last month's rate, with Bethlehem and Corporation mills operating at 80 per cent of capacity. Jones & Laughlin mills are running at 75 to 80 per cent. Mills in the Chicago district are operating at 80 per cent, which is a recent increase of 5 points. An indication of increased activity at the mills is the revival of demand for scrap. This demand is already reflected in the price. New York dealers, for example, are paying $10.35@$10.75 per ton, against $9@$9.75 a month ago.

Metal lath manufacturers face an advance of $2 per ton on steel sheets for fourth-quarter delivery. Prices on 2.2 weight are down $2 per 100 sq.yd. at Chicago and up $1.50 in Dallas warehouses.

Brick stocks at Hudson River plants are unusually low, according to shippers in the New York district. One billion, or 80 per cent of New York's yearly brick requirements, come from the Hudson River district. There is, therefore, a possibility of higher prices here. With no visible let-up in demand, weekly arrivals have dropped 2,000,000. Total wholesale receipts last week were 18,885,000, against 21,884,000 for the week before.

Douglas fir prices at Seattle hold to quoted levels, with a possibility of higher prices seen in the present restriction of production. The curtailment program agreed upon early in the summer is being practiced by a majority of the larger operators, mainly through the five-day week. Some, however, while running full time, are employing smaller crews.

Yellow pine prices at New Orleans are steady, with much less price cutting than has recently been the practice. Pine shipments are running 12 per cent and sales 25 per cent ahead of the weekly

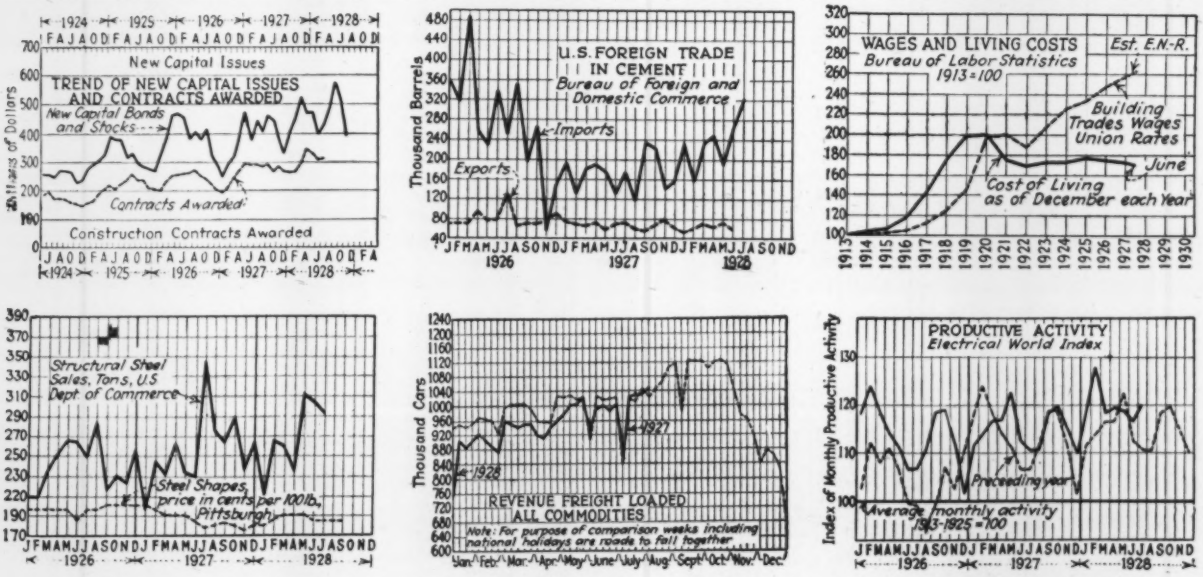
Construction Cost and Volume Index Numbers

Engineering News-Record Construction Cost Index Number is 207.29, unchanged from the Aug. 1 level. It is 3.69 points higher than a year ago.

The Construction Volume Index Number is 40 points higher than for July and is exactly the same as that for August, 1927.

Monthly figures for the years 1927 and 1928 follow:

E. N.-R. Cost		E. N.-R. Volume	
Sept., 1928	**207.29**	**August, 1928**	**306**
August, 1928	207.29	July, 1928	266
Sept., 1927	203.60	August, 1927	306
Peak June, 1920	273.80	1927 (average)	263
1927 (average)	206.24	1926 (average)	228
1913 (average)	100.00		
1927		1927	
January	211.50	January	187
February	210.15	February	182
March	208.80	March	226
April	209.00	April	257
May	206.80	May	299
June	205.55	June	297
July	203.68	July	252
August	205.50	August	306
September	203.60	September	273
October	204.40	October	269
November	201.98	November	272
December	203.90	December	319
1928		1928	
January	203.90	January	208
February	204.65	February	225
March	204.65	March	318
April	206.40	April	316
May	207.00	May	299
June	206.15	June	308
July	206.65	July	266


1924 1925 1926 1927 1928
New Capital Issues
TREND OF NEW CAPITAL ISSUES AND CONTRACTS AWARDED
New Capital Bonds and Stocks
Contracts Awarded
Construction Contracts Awarded
Millions of Dollars
U.S. FOREIGN TRADE IN CEMENT
Bureau of Foreign and Domestic Commerce
Imports
Exports
Thousand Barrels
1926 1927 1928
WAGES AND LIVING COSTS
Bureau of Labor Statistics
1913 = 100
Est. E.N.-R.
Building Trades Wages Union Rates
June
Cost of Living as of December each Year
Structural Steel Sales, Tons, U.S. Dept. of Commerce
Steel Shapes, price in cents per 100 lb., Pittsburgh
1926 1927 1928
Thousand Cars
1927
1928
REVENUE FREIGHT LOADED ALL COMMODITIES
Note: For purpose of comparison weeks including national holidays are made to fall together.
PRODUCTIVE ACTIVITY
Electrical World Index
Index of Monthly Productive Activity
Preceding year
Average monthly activity 1913-1925 = 100
1926 1927 1928

NEW CAPITAL ISSUES AND CONTRACTS—MOVEMENT OF MATERIALS—ELECTRICAL ENERGY CONSUMED

output of 71,000,000 ft., thus insuring mills against danger of excessive reserve stocks.

Chicago lumber dealers report lively business during the last 30 days, while hemlock in the Minneapolis market is in greater demand than has been the case for several years. Prices tend upward in Southern hardwood, pine and Northern hemlock, Northern white pine and fir. Dry stocks at mills are limited.

Building Trades Mechanics Are Working Quietly

Two strikes occurred in the building trades during August, compared with none in July and two in August, 1927, according to reports received from principal cities. These strikes were called by plasterers in Providence and building trades mechanics in Pittsburgh because of the hiring of non-union workers.

In Westchester County (New York) 300 lumber-mill workers—chiefly cabinet-makers, benchman and machinemen—are on strike. These men, who receive $9.50 per day, demand a five-day week with pay for five and one-half days. At Fall River and New Bedford, textile workers are striking in opposition to the 10 per cent wage reduction of April 16, 1928.

Local Conditions in August

Detroit employment reached the highest point in the city's history during the week ended Aug. 7, with 278,040 workers on full time. This peak exceeds the total of the corresponding week of 1927 by 53,000 workers and is 4,000 in excess of the highest previous total, which was in March, 1926.

San Francisco building trades are working five days during the summer, except on rush contract jobs.

Philadelphia plasterers accepted a cut of $1 per day, to $12, and employers agree to hire union labor exclusively. The agreement is for five years, with $12 the rate for the first year and $13 for the remaining four.

New York agreements between building trades and employers expire in October, 1929. No demands will be made before then.

Dallas reports a surplus of all building mechanics. Unions claim greater unemployment than prior to 1917.

Washington reports 90 per cent (15,000) of its building mechanics employed, whereas only 70 per cent were employed at the beginning of the spring building season.

St. Louis reports building trades active. In other vocations the situation is so severe that all police stations have been constituted employment bureaus. Steel mills and kindred industries are working at 65 to 90 per cent capacity, while the automobile industry payrolls are larger than a year ago. Agriculture will call for much labor in the next few weeks. Present supply of unskilled workers is far in excess of demand.

In Chicago, plasterers and painters appear to be the only building crafts in full employment.

In Denver, 85 to 90 per cent of the building trades mechanics are employed, which is a fairly high average.

Baltimore looks for better conditions in the fall, when a large school building program is expected to start.

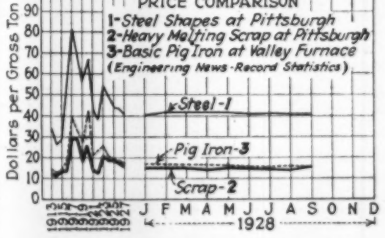
Minneapolis reports no unemployment, with the leading industrial employment bureau unable to meet demands for machine shop and foundry mechanics. Full employment in the building trades is expected for many months to come, owing to a program including a dozen or more buildings ranging in value from $300,000 to $1,500,000, on which contracts have already been awarded.

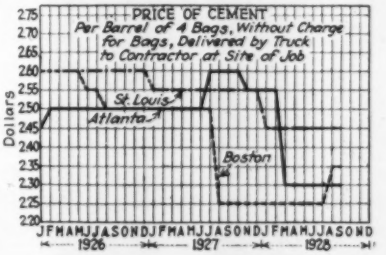
In Cleveland, construction has started on two new units of the $75,000,000 Union Terminal, and a number of large projects are in prospect for fall letting.

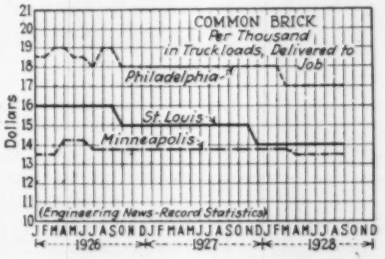
The average skilled labor rate for the country is $1.35 per hour, the same as in August. The September, 1927, rate was $1.33½. Common laborers receive an average rate of 56.07 cents per hour, the same as a month ago and slightly above the September, 1927, average of 54.55.

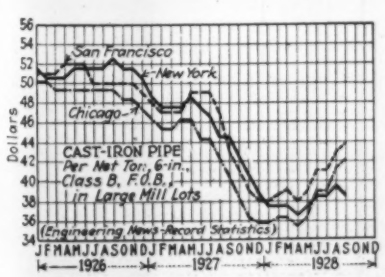
CURRENT BUILDING TRADES WAGE RATES PER HOUR

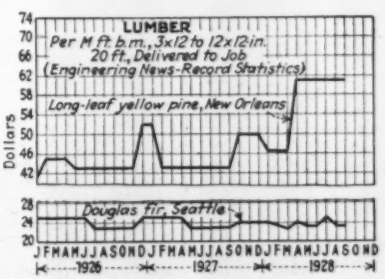
Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.25@1.40	$0.60@0.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.62½	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.75	.25@.40
Boston	1.40	1.25	1.25	.79	1.15	1.37½	.45@.74
Cincinnati	1.50	1.37½	1.37½	.92½	1.37½	1.37½	.45@.60
Chicago	1.62½	1.50	1.00@1.50	.90@.96¼	1.50	1.50	.90
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.87½
Dallas	1.67½	1.12½	1.25	.40@.75	1.25	1.25	.35@.50
Denver	1.50	1.25	1.25	.25@.87½	1.25	1.25	.50@.62½
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City	1.50	1.25	1.25	.90	1.25	1.25	.35@.75
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.50
Minneapolis	1.25@1.37½	.87½@.95	.87½	.75	.....	1.00	.45@.60
Montreal	1.12	.75	.75	.40	.50	.80@1.00	.30@.35
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90¼
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.75
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.40@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.45@.75
San Francisco	1.37½	1.12½	1.00@1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.50	1.12½	1.25	1.00	1.12½	1.25	.70

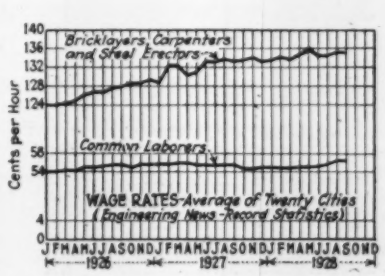












PRICES OF CONSTRUCTION MATERIALS AND WAGES OF LABOR

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type;** declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per bbl. delivered to contractors, in carloads, *without charge for bags.* Cash discount not deducted.

	Sept. 6, 1928	One Month Ago	One Year Ago
Atlanta	**$2.30**	$2.25	$2.40
Baltimore	2.65	2.65	2.50
Birmingham	2.60	2.60	2.40
Boston	2.35	2.35	2.05f.o.b.
Cedar Rapids (f. o. b.)	2.24	2.24	2.24
Chicago (f. o. b.)	2.05	2.05	2.05
Cincinnati (f. o. b.)	2.22	2.22	2.32
Cleveland (f. o. b.)	2.24	2.24	2.24
Dallas	2.40	2.40	2.05f.o.b.
Davenport (f. o. b.)	2.24	2.24	2.24
Denver	2.85	2.85	2.85
Detroit (f. o. b.)	**1.95**	1.90	2.15
Duluth (f. o. b.)	2.04	2.04	2.04
Indianapolis, (f. o. b.)	2.19	2.19	2.19
Jersey City	2.35	2.35	2.13f.o.b
Kansas City, Mo.	*2.20*	2.40	2.07f.o.b
Los Angeles	2.66	2.66	2.56
Milwaukee (f. o. b.)	2.20	2.20	2.20
Minneapolis (f. o. b.)	2.22	2.22	2.22
Montreal (f. o. b.)	1.41	1.41	2.22
New Orleans	2.20	2.40	2.50
New York	2.25@2.35	2.25@2.35	2.35
Peoria (f. o. b.)	2.22	2.22	2.22
Philadelphia	2.41	2.41	2.40
Pittsburgh (f. o. b.)	2.04	2.04	2.04
St. Louis	2.45	2.45	2.05f.o.b.
St. Paul (f. o. b.)	2.22	2.22	2.22
San Francisco	2.41	2.41	2.51
Seattle	2.70	2.70	2.65
Toledo (f. o. b.)	2.20	2.20	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b., to contractors:

Alpena, Mich.	**$1.65**	Leeds,Ala	$1.65
Buffington, Ind.	1.80	Lehigh Valley District	1.75
Clinchfield, Ga	1.65	Mason City, Ia.	1.80
Fordwick, Va.	2.05	Mitchell, Ind.	1.90
Hannibal, Mo.	1.90	North Birmingham, Ala.	1.45
Hudson, N. Y.	1.75	Richard City, Tenn.	1.85
Iola, Kan.	1.85	Steelton, Minn.	1.85
Kingsport, Tenn.	2.05	Universal, Pa.	1.80
La Salle, Ill.	1.90	Wyandotte, Mich.	**1.70**

SAND AND GRAVEL—Prices are per cu.yd. delivered. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd. unless otherwise specified in pounds.

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta, per ton	**$3.50**	**$3.50**	**$2.50**
Baltimore, per ton	2.40	2.60	1.70
Birmingham (2,600)	3.00	3.00	2.65
Boston, per ton	1.90	1.90	1.35
Chicago	*2.05@2.20*	*2.05@2.20*	*2.05@2.20*
Cincinnati, per ton	1.90	1.60	1.60
Dallas	2.50	2.50	2.25@3.00
Denver (2,700)	1.80	1.80	1.30
Detroit (2,600)	3.00	3.00	2.50
Kansas City, Mo.	2.40	2.40	.60 ton at pit
Los Angeles, per ton	*2.15*	*2.15*	*1.30*
Minneapolis (2,800)	2.25 ton	2.25 ton	1.00
Montreal, per ton	1.90	1.50	1.20
New Orleans (2,700) (2,500)	2.75	2.75	1.75
New York	3.25@3.50	3.25@3.50	2.00@2.25
Philadelphia, per ton	2.05@2.90	2.05@2.90	1.40@2.25
Pittsburgh, per ton, f.o.b.	1.05	.85	1.25
St. Louis, per ton	2.30	2.30	1.90@2.30
San Francisco (bunkers) (2,800)	1.80	1.80	1.40
Seattle (3,200) (2,850)	1.00	1.00	1.00

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Prices are per cu.yd. delivered. Weight 1½ tons per cu. yd., unless specified in pounds:

	1½ In.	¾ In.
Atlanta, per ton	**$3.00**	**$3.00**
Baltimore, per ton	2.75	2.85
Birmingham, Limestone	2.50	2.50
Boston, per ton	2.25	2.25
Chicago, Limestone	*2.05@2.20*	*2.05@2.20*
Cincinnati, per ton	2.25	2.25
Cleveland, per ton	3.00	3.00
Dallas	3.25	3.40
Denver, Granite (2,700)	2.50	2.50
Detroit, Limestone, per ton	2.50	2.60
Kansas City, Limestone, per ton, (2,450)	2.50	2.50
Los Angeles, per ton	*2.15*	*2.15*
Minneapolis, Limestone, per ton	2.25	2.25
Montreal, per ton	2.10	2.10
New York, Limestone	3.25@3.50	3.25@3.50
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh, per ton, f.o.b.	2.75	2.75
St. Louis, per ton	*2.20*	*2.20*
San Francisco, Trap rock, bunkers (2,400)	1.70	1.70
Seattle, (2,700)	1.90	1.90

CRUSHED SLAG—Price of crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala.	**$.90**	**$1.25**	**$2.05**	**$0.80**
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.20	1.20	.....	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	.....	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Price of hollow building tile per block delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.0808	.....	**$0.1516**	.....	**$0.2232**
Baltimore	**.095**	.....	.173	.....	.232
Birmingham	.09	**$0.127**	.174	.....	.....
Boston	**.08**	**.1025**	**.14**	**$0.1775**	**.24**
Chicago	.076	.104	.142	.182	.202
Cincinnati	.074	.....	.136	.....	.205
Cleveland	.06	.....	.128	.....	.....
Dallas	*.096*	.1205	.1785	.284	.....
Denver	.0975	.135	.175	.2125	.25
Detroit	.092	**.127**	.208	**.256**	.293
Kansas City	.0535	.....	.158	.....	.242
Los Angeles	.085	.122	.172	.....	.285
Minneapolis	.0842	.....	**.1476**	.....	.2441
Montreal	.12	.....	.22	.....	.315
New Orleans	.09	.....	.165	.....	.245
New York	.0973	**.1459**	.1824	.2313	.3084
Perth Amboy, N. J. (f.o.b.)	.....	.....	.....	.....	.....
Philadelphia	.11	.145	.22	.27	.34
Pittsburgh	.068	.....	.1175	.....	.1726
St. Louis	.078	.105	.145	.175	.210
San Francisco	.108	.156	.255	.....	.....
Seattle	.10	.....	.18	.....	.26

BRICK—Contractors price, delivered, per M, is as follows:

		Paving	
	Common	3x8½x4-in.	3½x8½x4-in
Atlanta	$13.75	$38.00	$45.00
Baltimore	15.00	40.00	45.00
Birmingham	15.00	32.00	36.00
Boston	17.50	45.00	51.00
Chicago	12.00	42.00	45.00
Cincinnati	18.00	40.00	45.00
Cleveland	14@16	.....	.....
Dallas	*13.00*	35.00	.....
Denver, salmon	12.00	.....	.....
Detroit	15.50	35.50	38.50
Kansas City	14.00	.....	.....
Los Angeles	11.00	.....	.....
Minneapolis	13.50	.....	.....
Montreal	20.33	.....	.....
New Orleans	16.00	40.00*	50.00
New York	17@20	45.00	51.00
Philadelphia	17.00	40.00	46.00
Pittsburgh	17.00	.....	.....
St. Louis, salmon	14.00	40.00	42.50
San Francisco	13.00	.....	.....
Seattle	14.50	50.00	55.00

*2½x8½x4 in.

LIME—Prices delivered to job:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
Atlanta	**$27.50**	$15.00	$2.30†	$2.10†
Baltimore	20.00	14.00	2.55†	.....
Birmingham	22.00	16.00	2.40†	1.85†
Boston	20.00	14.00	3.85*	3.00*
Chicago	20.00	18.00	.....	1.50†
Cincinnati	16.80	13.20	.....	13.20‡
Dallas	*19.50*	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Kansas City	20.00	17.50	2.62†	**2.25**†
Los Angeles	*25.00*	18.00	**2.85**†	*17.00*‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	21.00	21.00	.....	15.00‡
New Orleans	.....	.....	.....	2.80*
New York	21.00@22.00	14.00@15.00	4.00@4.10*	3.15@3.25*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	22.00	18.00	.....	.....
St. Louis	24.00	18.00	2.50†	15.00‡
San Francisco	27.50	20.00	.....	1.70†
Seattle, paper sacks	24.00	.....	.....	**2.80***

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Boston	$18@.20	Minneapolis, f.o.b.	$0.14
Brooklyn and Queens	*15@.17*	New Orleans	.22
Cleveland	.17@.18	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.18
Detroit	.15	St. Louis	.18

Road and Paving Materials

PAVING STONE—Prices, f.o.b., in carloads or cargo lots for granite blocks 4x8x4-in. dressed:

Atlanta	**$3.00** per sq.yd
Baltimore	3.00 per sq.yd
Boston, 5 in.	135.00 per M.
Chicago, 5 in.	3.25@**3.90** per sq.yd
Cincinnati	110.00 per M.
Detroit, 5 in.	3.00 per sq.yd
Kansas City	3.50 per sq.yd
Minneapolis, Sandstone	2.74 per sq.yd
Montreal	104.75 per M.
New Orleans	2.75 per sq.yd
New York, Grade 1, 30 blocks per sq.yd	150.00 per M.
Philadelphia	125.00 per M.
St. Louis	3.30@3.40 per sq.yd
San Francisco, Basalt block, 4x7x8	70.00 per M.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices f.o.b. in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	18	2.40
Chicago	3½	16	2.10
Cincinnati	3½	16	2.35
Dallas	4	18	3.90
Detroit	3½	16	1.94
Kansas City	3½	16	3.85
Minneapolis	3½	16	2.50
Montreal	4	16	4.50
New Orleans	3½	16	2.30
New York	3½	16	2.70
St. Louis	3½	16	2.20

FLAGGING—Prices in fair-sized quantities, alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.; Cross-walk, 6x24-in., $1.30 per lin.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, New York, 5x16 in., rough, 90c. per lin.ft., cutting charges extra.
Birmingham: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft.
St. Louis: Class "B" straight, delivered, 5x16 in., 80c. per lin.ft.; roundings, $1.15 per lin.ft.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
Atlanta (Mexican)	$22.60	$18.40
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	21.00
Boston (Mexican)	24.50	*18.50*
Chicago (Texas)	24.50	21.30
Cincinnati (Kentucky Rock)	....	11.65
Dallas (Texas)	26.00	....
Denver (California)	35.00	....
Detroit (Mexican)	24.00	19.00
Kansas City, Mo. (Texas)	27.00	25.00
Los Angeles ("D" Grade, Calfornia, f.o.b. El Segundo)	18.00	12.00
Maurer, N. J. (Bermudez)	30.00	....
Maurer, N. J. (Trinidad)	23.00	....
Minneapolis, (Stanolind, f.o.b. Twin Cities)	28.10	22.10
Montreal (Imperial)	28.00	21.50
New Orleans (Mexican)	20.00	17.00
New York (Texas)	24.50	16.50
Philadelphia (Mexican)	20.00	18.00
St. Louis (Mexican)	23.50	19.50
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle, ("D" grade, California, f.o.b Richmond refinery)	19.50	13.50

ROAD OILS—Price, f.o.b. in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt		$0.0525
Birmingham, 50@60% asphalt		.0475
Dallas, 40@50% asphalt		.061
Dallas, 50@60% asphalt		.06
New York, 40@50% asphalt	(at terminal)	.0625 @ .075
New York, 50@60% asphalt	(at terminal)	.0625 @ .072
St. Louis, 40@50% asphalt		.0418
St. Louis, 50@60% asphalt		.0407

Iron and Steel

PIG IRON—Per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 2.25@2.75	$16.25
Pittsburgh, basic, incl. freight ($1.76) from Valley	19.26

STRUCTURAL STEEL—Per 100 lb.:

	Shapes, 3 to 15-In.	Plates, ¼-In
Birmingham, large mill lots, f.o.b.	$2.05	$2.05
Chicago, warehouse, delivered	3.10	3.10
Dallas, warehouse, delivered	3.75	3.75
New York, warehouse, delivered, 250 to 3,999 lb.	3.30	3.30
Pittsburgh, large mill lots, f.o.b.	1.85	1.85
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	3.25	3.25

BARS, CONCRETE REINFORCING—Per 100 lb. for ½-in.:

Birmingham, large mill lots, f.o.b.	$2.05
Chicago, warehouse, delivered	2.30@3.00
Dallas, warehouse, delivered	*3.50*
New York, warehouse, delivered, 250 to 3,999 lb.	3.25
Pittsburgh, large mill lots, f.o.b.	1.95
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.25

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered to job in less-than-carload lots:

Lb. per Sq. Yd.	New York	Bir-mingham	Chicago	St. Louis	Dallas	San-Francisco
2.2	$15.00	$19.00	*$14.00*	$21.00	$21.50	$18.50
2.5	16.00	20.00	*15.00*	22.00	24.00	19.50
3.0	17.50	22.50	*16.50*	24.50	....	22.00
3.4	20.00	24.50	*18.00*	26.00	30.00	24.00

WIRE REINFORCEMENT FOR CONCRETE—Price per 100 sq.ft.in carloads at mills; from warehouses in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pitts-burgh Mill	Chicago District Mill	Warehouse: New York	Warehouse: St. Louis	Warehouse: Dallas	Warehouse: San Fran-cisco
032	22	$0.99	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.26	1.29	1.76	1.35	1.38	1.55
068	35	1.54	1.58	2.18	1.66	1.67	1.91
093	45	1.98	2.03	2.79	2.13	2.00	2.46
126	57	2.45	2.51	3.45	2.63	2.55	3.03
153	68	2.92	2.99	4.13	3.14	3.15	....
180	78	3.35	3.43	4.73	3.60	3.47	....

STEEL SHEETS—Per 100 lb.:

	Blue Annealed No. 10	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	*$3.35*	*$3.80*	*$4.65*
New York, warehouse, delivered	3.90*	4.20	4.95
Pittsburgh, large mill lots, f.o.b.	2.10@2.20	2.65@2.75	3.40@3.60
St. Louis, warehouse, delivered	3.60	4.45	5.25
San Francisco, warehouse, delivered	4.00	5.00	5.40

*250 to 3,999 lb.

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (*add to list*)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	5%
Special steel round strand rope	30%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Per 100 lb., full packages:

	Round-head Structural, ½-In.	Cone-head Boiler, ½-In.
Chicago, warehouse, delivered	$3.60	$3.90
Dallas, warehouse, delivered	5.00	5.30
New York, warehouse, delivered	5.00	5.30
Pittsburgh, large mill lots, f.o.b.	2.90	3.20
St. Louis, warehouse, delivered	3.75	4.05
San Francisco, warehouse, delivered	5.75	6.05

STEEL SHEETPILING—The base price f.o.b. Pittsburgh for large mill lots is $2.25 per 100 lb.

SHIP SPIKES—Per 100 lb., black, from warehouse stocks; galvanized about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	$5.80	$5.10	$4.95
Seattle	7.75	5.65	5.50

Pittsburgh base in lots of 200 kegs or more, $3.00 per 100 lb.

NAILS—The following quotations are per 100 lb. keg delivered from warehouse stocks, also Pittsburgh mill base:

	Pittsburgh Mill	Birming-ham	Chicago	St. Louis	Dallas	San Francisco	Mon-treal
Wire	$2.55	$3.10	$3.10	$2.75	*$3.75*	$3.60	$4.95
Cut	*2.70*	3.30	....	....	5.00	5.00	5.00

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	$10.00@$10.50	$12.75@$13.25	....
Stove plate	8.75@ 9.00	13.00@13.50	....
No. 1 machinery cast	12.50@14.00	15.00@15.50	$14.00
Machine shop turnings	6.25@ 6.50	7.25@ 7.75	7.00
Cast borings	6.00@ 6.50	9.50@10.00	8.25
Railroad malleable	10.00	13.00@13.50	....
Re-rolling rails	10.50@11.00	15.50@16.00	13.00
Re-laying rails, 56@60 lb.	23.00@24.00	23.00@25.00	....
Heavy melting steel, No. 1	10.35@10.75	12.75@13.25	12.00
Iron and steel pipe	9.25	....	8.00

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.71*
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15†
Chicago	.34	Philadelphia	.32
Cincinnati	.27	St. Louis	.405
Cleveland	.19	St. Paul	.60
Denver	1.15†		

*Except iron or steel pipe and fittings. †Minimum weight on structurals, 60,000 lb.

Railway Materials and Supplies

STEEL RAILS—Per gross ton, f.o.b., for large mill lots:

	Pitts-burgh	Birming-ham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00
Standard openhearth rails	43.00	43.00	43.00
Light rails, 25 to 45 lb.	36.00	34@36	36@38
Re-rolled rails	30@32	34@36	....

RAILWAY TIES—For fair-sized orders, f. o. b., the following prices per tie hold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application.		
Birmingham	Southern pine, untreated	1.10	1.25
	Southern pine, creosoted	1.60	1.75
Chicago	White oak, untreated	1.40	1.78
	Oak, empty cell, creosoted	1.80	2.40
	Oak, sine treated	1.60	2.10
	Southern pine, creosoted	1.60	2.10
St. Louis	White oak, untreated	1.20	1.80
	Red oak, creosoted	1.50	2.30
San Francisco	Sap pine or cypress, untreated	1.00	1.60
	Douglas fir, green, untreated	.82	1.14
	Douglas fir, empty cell, creosoted	1.73	2.32
Montreal	Birch or maple, untreated	.75	1.25
	Birch or maple, creosoted	1.25	1.55

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Per 100 lb. f.o.b. Pittsburgh mill for large mill lots together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, ⅜-in. and larger	$2.80	$3.55	$3.00	$3.65	$3.85
Track bolts	3.80	4.55	3.90	4.65	5.35
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.00	4.25	4.25
Tie plates	2.15	2.15*	.....	2.58	.....

*At Chicago mills in carloads.

Pipe

WROUGHT-STEEL PIPE—Discounts from standard list:

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	54%	41%	51%	38%
New York, warehouse, delivered	50%	36%	45%	32%
Pittsburgh, large mill lots, f.o.b.	62%	50½%	59%	47½%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Price per net ton for bell and spigot pipe, Class B and heavier, f.o.b., in large mill lots:

	4-In.	6-In. and Over
Birmingham mill	$37.00	$34.00
Burlington (N. J.) mill	*39.00*	*36.00*
Chicago	45.20@46.20	42.20@43.20
New York	*41.60*	*38.60*
Pittsburgh	45.50	42.50
St. Louis	42.60	39.60
San Francisco	47.00	44.00

Gas pipe and Class A $3.00 per ton extra.

SEWER PIPE—Prices are delivered in cents per foot for standard pipe; 6, 8 and 12-in. single strength and 18, 24, 30 and 36-in. double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.20	$0.34	$0.75	....	$1.70	.....	.....
Baltimore	.16	.24	.46		1.53	.....	$6.50
Birmingham	.135	.2215	.4015	$1.4685	2.665	$3.90	5.06
Boston	.15	.27	.51	1.20	1.85	3.00	5.50
Chicago	.16	.28	.54	1.25	2.25	.....	.....
Cincinnati	.135	.21	.405	.75	1.35	2.16	4.8175
Dallas	.256	.42	.794	1.70	3.00	.....	.....
Denver (f.o.b.)	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	.....	.....
Kansas City	.21	.29	.52	....	1.90	3.80	.....
Los Angeles	.21	.27	.486		1.74	.....	.....
Minneapolis (f.o.b.)	.1575	.25	.45	.85	1.80	3.75	4.94
Montreal	.36	.53	.78	1.48	2.75	4.20	.....
New Orleans	.195	.325	.5525	1.105	2.112	.....	.....
New York	.20	.32	.61	1.50	2.70	5.12	7.91
Philadelphia (f.o.b.)	.117	.182	.351	1.025	1.845	3.60	5.6375
Pittsburgh (f.o.b.)	.0945	.147	.2835	.90	1.62	3.024	4.8175
St. Louis	.1645	.26	.468	1.092	1.872	3.65	4.80
San Francisco	.21	.30	.54	1.32	2.16	3.60	.....
Seattle	.22	.30	.54	1.26	2.16	3.60	.....

CLAY DRAIN TILE—Prices are delivered per 1,000 lin.ft.:

Size, In.	New York	Birmingham	St. Louis	Dallas	San Francisco
3	$45.00	$45.00	$50.00		
4	56.00	56.00	50.00	$73.00	$67.50
5	.....	80.00	85.00	110.00	86.25
6	90.00	105.00	85.00	118.00	112.50
8	150.00	175.00	195.00	150.00	175.00

Miscellaneous

LINSEED OIL—Raw oil, f.o.b. in 1- to 4-bbl. lots, per lb.:
New York....*$0.105* Chicago....*$0.103* Minneapolis....*$0.11*

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York: White, dry or in oil, $13.25; Red, dry, $13.25; Red, in oil, $14.75.

CHEMICALS—Water and sewage treatment chemicals, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	5.30@ 5.50
Soda ash, 58%, in bags, per 100 lb	1.32@ 1.35
Chlorine, liquid, cylinders, per lb	.05½@ .08
Bleaching powder, in drums, f.o.b. works, per 100 lb	2.00@ 2.10

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ¼-in., 8-ft.; ⅜-in., 6-ft.; ½-in., 4½-ft.; ⅝-in., 3¼-ft.; ¾-in., 2-ft.; 1-in., 2-ft. 4 in. Following are prices per pound for ½-in. and larger delivered in 1,200-ft. coils:

Atlanta	$0.25	Kansas City	$0.26
Baltimore	.22½	Los Angeles	.25
Birmingham	.35@.40	Minneapolis	.23
Boston	.25	Montreal	.24½
Chicago	.21	New Orleans	.23½
Cincinnati	.21	New York	.24
Cleveland	.30	Philadelphia	.24
Dallas	.21	San Francisco	.21½
Denver	.24	Seattle	.21½
Detroit	.24½	St. Louis	.21½

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carloads:

Tar felt per, 100 lb	$3.27½
Asphalt coating, per gal	.40
Asphalt felt, per 100 lb	3.50

PREPARED ROOFINGS—Prices to contractors, in carloads, f.o.b., New York per square:

Single shingles, slate finish, sufficient to cover 100 sq.ft.	$6.12½
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	5.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs	2.50

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Mar. 1, 1913), at New York warehouses:
AA ....83⅓% A ....88% B 89%

EXPLOSIVES—Prices per pound for dynamite delivered in small lots:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.1967	.2173
Birmingham, f.o.b.	.155	.185	Montreal	.195	.22
Boston	.25	.275	New Orleans	.235	.26
Chicago	.195*	.22*	New York	.26‡	.2825‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.24	.29	St. Louis	.215	.24
Denver, f.o.b.	.1925	.215	San Francisco	.1625	.1925
Kansas City, Mo.	.2025	.2225	Seattle	.16	.185

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

San Francisco—Prices of rough Douglas fir, No. 1 common, at yards; prices delivered to contractor at site of job, $1.50 to $5 per M. ft. additional:

	10-16-18 and 20 Ft. No. 1 Douglas Fir	22 and 24 Ft. No. 1 Douglas Fir
3x3 and 4	$28.00	$29.00
3x6 and 8	28.00	29.00
3x10 and 12	28.00	29.00
3x14	31.00	33.00

Chicago—Prices, f.o.b., in carloads, per M. ft. b.m.; prices delivered to job in truckloads from stock, $10 per M. ft. additional:

	20 Ft. and Under No. 1 Long-Leaf Yellow Pine	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	$37.50	$41.50
3x10 to 10x10	46.50	41.50
3x12 to 12x12	56.50	41.50
3x14 to 14x14	.....	42.50

New York—Prices per M. ft., b.m., wholesale, for rough, long-leaf, yellow-pine timbers in quantities of 35,000 ft. or more, within lighterage limits:

	20 Ft. and Under Long-Leaf Yellow Pine	22-24 Ft. Long-Leaf Yellow Pine
3x4 to 8x8	$41.00@$43.00	$42.00@$44.00
3x10 to 10x10	48.00@ 50.00	49.00@ 51.00
3x12 to 12x12	55.00@ 57.00	56.00@ 58.00
3x14 to 14x14	63.00@ 65.00	64.00@ 66.00

Other Cities—Prices delivered per M.ft., b.m.:

	8x8-In. x 20 Ft. and Under, Rough				3x12 to 12x12-In. 20 Ft. and Under, Rough	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	$45.00	.....	.....	.....	$65.00	.....
Baltimore	36.00	$50.25	$54.00	$61.50	75.00	$50.50
Birmingham	35.00	.....	.....	.....	40.00	.....
Boston	48.00	47.00	47.50	50.00	56.50	50.00
Cincinnati	36.00	49.00	47.00	47.00	40.00	*53.00*
Dallas	57.50	57.50	.....	.....	57.50	57.50
Denver	.....	*56.00*	.....	.....	57.00	45.00
Detroit	55.00	55.00	.....	.....	65.00	54.50
Kansas City, Mo.	40.50	38.75	.....	.....	53.50	48.75
Los Angeles	.....	44.00	.....	.....	.....	44.00
Minneapolis	53.00	48.25	36.25‡	.....	53@55	48.25@49.75
Montreal	50.00	55.00	.....	.....	49.00	48.00
New Orleans	40.00	56.00	.....	.....	61.00	55.00
Philadelphia	57.00	37.00	44.00	45.00	67.00	37.00
St. Louis	43.00	38.00	38.00	43.00	53.00	39.00
Seattle	.....	23.00	.....	.....	.....	22.50

	1x10 In. x 16 Ft. and Under, Rough			2x10 In. x 16 Ft T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	$47.50	.....
Baltimore	56.00	$45.00	$45.00	35.00	$48.00
Birmingham	36.00	.....	.....	48.00	.....
Boston	44.00	42.75	44.00	48.50	47.50
Cincinnati	30.00	35.00	33.00	31.00	48.00
Dallas	.....	.....	.....	57.50	.....
Denver	.....	44.00	31.25	.....	44.00
Detroit	40.00	.....	.....	38.00	.....
Kansas City, Mo.	59.00	44.25	.....	42.75	36.75
Los Angeles	.....	38.00	.....	.....	57.00
Minneapolis	48.00	42.00	38.75‡	48.00	43.00
Montreal	45.00	48.00	40.00	85.00	70.00
New Orleans	36.00	.....	.....	44.00	.....
Philadelphia	54.00	38.50	38.00	56.00	38.50
St. Louis	43.00	.....	.....	31.00	.....
Seattle	.....	22.50	.....	.....	23.00

*Long-leaf yellow pine. †Douglas fir. ‡F.o.b.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41½